# 3.0 ENVIRONMENTAL ANALYSIS[15]

In this section, we describe the resources that are part of the affected environment and provide an analysis of the potential effects on these resources. Because implementation of protection, mitigation, and enhancement measures would affect project economics and other resources, we make our recommendations in section 5.1, Comprehensive Development and Recommended Alternative. Project economics are discussed in section 4.0.

## HYDROPS Modeling

Much of the analysis in this draft EIS is based on Puget's PDEA which was developed in collaboration with the Settlement Parties and filed along with Puget's license application. In developing the PDEA, Puget and the Settlement Parties relied heavily on the HYDROPS optimization model for testing different project operational scenarios and for evaluating project effects. The HYDROPS optimization model is used to specify the operating characteristics of hydroelectric plants and to optimize the operation of the plants to maximize potential revenues while meeting environmental and operational constraints. It was developed by the Powel Group and was tailored to the needs of the Baker River Project in consultation with Puget. The information to support model input and organize model results is stored in a series of databases.

The "engineering module" specifies the operating and physical characteristics of the plant including turbine performance characteristics (efficiency, generation limitations, rough zones, flow and head constraints), tailwater elevation curves, reservoir storage elevation curves, and rating curves for USGS gages. This module provides the engineering information necessary to operate the "study model." The "study model" allows the user to design a specific operational scenario to evaluate both economic and environmental effects associated with a specified alternative.

Several types of operating constraints and input parameters are also specified in the "study model" including the following: (1) maximum and minimum reservoir elevations; (2) maximum and minimum total release (can be specified below Upper Baker dam, below Lower Baker dam, and the Skagit River below the Baker River confluence; (3) maximum and minimum powerhouse generation; (4) maximum and minimum system generation (both Upper and Lower Baker); (5) maximum and minimum powerhouse discharge; (6) maximum and minimum spill; (7) ramping rates either by level or flow or a combination thereof; (8) turbine maintenance schedule; and (9) monthly peak and off-peak energy prices. These constraints can be specified as hard constraints (must be met or the run becomes infeasible and terminates) or soft constraints (may be violated, but violations are reported to the user). Soft constraints are prioritized allowing the user to specify which constraints they would like to see violated first.

[15] All information is from Puget (2005a) unless otherwise indicated.

The "study model" is used to produce reports containing operation summaries, energy generation, and revenues. Additionally, the model provides inputs to other hydrologic and habitat models used to evaluate project effects.

The hydrologic input data set includes unregulated flow into the Upper Baker reservoir, accretion between Upper Baker dam and the Baker River confluence with the Skagit River, and historical flow in the Skagit River upstream of the Baker confluence. The hydrology is based on representative energy years. Puget selected five energy years (August 1 of the previous year through the end of July of the energy year) with the goal of providing a representative analysis while limiting the need for processing numerous years through the model. The five selected years along with their general hydrologic characteristics are as follows: (1) 2001 – very dry, (2) 1993 – somewhat dry, (3) 1995 – average, (4) 2002 – somewhat wet, and (5) 1996 – very wet.

The selection process focused on both biological resources and hydrologic conditions. To capture realistic Upper Skagit River flows, the selection of years was restricted to the years of 1991 – 2002 to reflect post-licensing operations at the Skagit River Project. Average unregulated Baker River flow from the five selected years is 97 percent of the long-term (energy years 1976 – 2002) average flow. Comparison of the unregulated Baker River flows indicate that the flow duration curves for the typical reservoir drawdown and refill periods are very similar for the selected period and the long-term conditions.

## 3.1 GENERAL DESCRIPTION OF THE BASIN[16]

The Baker River watershed covers 297 square miles and ranges in elevation from 10,778 feet msl at the summit of Mt. Baker to 160 feet msl at the confluence of the Baker and Skagit rivers near the Town of Concrete. The Baker River is the second largest tributary to the Skagit River, which, in turn, is the largest drainage in Puget Sound. The Baker River's average annual flow contribution to the Skagit River is about 16 percent.

The headwaters of the Baker River are in the northeastern portion of the watershed and originate from glaciers and snowfields on Mt. Baker, Mt. Shuksan (elevation 9,127 feet msl) and nearby peaks. From its headwaters, the Baker River flows toward the southwest and reaches the valley floor (elevation 1,000 feet msl) after about 5 miles. From this point, the Baker River valley continues in a southwesterly to southerly direction for about 25 miles to its confluence with the Skagit River. Lake Shannon and Baker Lake occupy about 16 lineal miles of the Baker River valley. Prior to project construction, historical documents indicate that Baker Lake existed as a natural lake

[16] This general basin description is based on Puget (2002b) and on Forest Service (2002a).

occupying about 550 acres of the valley bottom within the northern half of Baker Lake's current footprint.

Over 60 tributary streams totaling approximately 315 miles enter the Baker River, primarily discharging into Lake Shannon and Baker Lake. The primary tributary streams include Swift, Park, Boulder, Noisy, Thunder, Sulphur, Rocky, and Bear creeks. A number of the tributaries on the west side of the basin (e.g., Swift, Boulder, and Park creeks) are glacial streams, heavily dominated by glacial sediment.

The Baker River watershed is generally very steep, with slopes from 20 to 40 percent over most of its area, with the exception of the valley bottom along the Baker River channel and some of its major tributary streams. The lower basin consists of a wide, unconfined valley floor composed of glacial and stream sediments, into which the Baker River has carved a narrow canyon up to 500 feet deep. Lake Shannon occupies much of this canyon. The middle portion of the basin, site of Baker Lake, is a more confined valley where glacial and stream sediments have been covered by mudflows and recent alluvial deposits. The upper basin is a narrow rock canyon with a valley floor of recent deposits of sand and gravelly material. At the upper reaches of the watershed, Mt. Baker, Mt. Shuksan, and their adjacent ridges and pinnacles form a spectacular alpine topography that dominates the landscape.

The watershed lies in a convergence zone between Pacific weather systems from the west and Arctic weather systems from the north. During the summer, the Pacific systems dominate and bring periods of generally clear weather and reduced precipitation. During the winter, the Arctic systems usually dominate, with winter storms and increased precipitation. Lower temperatures at higher elevations in the watershed result in heavy snow in winter, a portion of which is stored in ice fields and glaciers. Average annual precipitation ranges from about 70 inches at Concrete to greater than 150 inches at some of the higher elevations.

The main access into the watershed is afforded by the Baker Lake Highway (also known as Baker River Highway and Forest Service Road 11), which begins at the junction with the North Cascades Highway about 6 miles west of Concrete. Land ownership and management in the watershed is dominated by federal government holdings in the Mt. Baker-Snoqualmie National Forest (55.6 percent of the total watershed area) and in North Cascades National Park (30.4 percent). Over 99 percent of the watershed above Upper Baker dam (RM 9.35) consists of federal lands. Private and state holdings account for the remaining 14 percent of the watershed's area. The private and state holdings are primarily confined to the lower watershed tributaries entering Lake Shannon and to the Lower Baker River downstream of Lake Shannon.

About 49 percent of the watershed is managed as wilderness, roadless areas, or national park. Recreation and management of lands for protection of natural values are

the predominant land uses in the watershed. Most of the 14 percent of land in private and state ownership has been extensively harvested and is managed for silviculture. The Baker River Project, including Baker Lake and Lake Shannon, occupies about 5 percent of the watershed.

Small hydroelectric projects were constructed in the watershed around 1906 to power cement operations in the Town of Concrete, but they were later abandoned. The two developments of the Baker River Project were completed in 1925 and 1959. In the early 1980s, there was renewed interest in small hydropower, and by 1990, 13 potential projects had been studied. Only one project (Koma Kulshan) has been built. This project (FERC Project No. 3239) went into operation in 1990 and diverts water from Rocky and Sulphur creeks to a power plant on Sandy Creek. By letter orders dated March 7, 2003, and May 30, 2003, the Commission dismissed applications for projects on Lower Rocky Creek (FERC Project No. 10311) and on Anderson Creek (FERC Project No. 10416), respectively. By order dated April 18, 2005, the Commission terminated the license for a project on Bear Creek (FERC Project No. 10371) for failure to start construction.

## 3.2 CUMULATIVELY AFFECTED RESOURCES

According to the Council on Environmental Quality's regulations for implementing NEPA (section 1508.7), a cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The following resources may be cumulatively affected by the project in combination with other past, present, and future activities: instream flows, water quality, sediment supply and transport, fishery resources (anadromous and resident fish), wildlife habitat, recreation, and cultural resources.

In the following subsections, we discuss the geographic and temporal scope of our analysis of these cumulatively affected resources. Past actions that have affected the above-listed resources are briefly described in the Affected Environment sections for each resource. The cumulative effects analysis at the end of each resource section summarizes the potential for the Proposed Action to contribute to cumulative effects of past, present, and future activities on these resources.

### 3.2.1 Geographic Scope

The geographic scope of the analysis defines the physical limits or boundaries of the Proposed Action's effects on the resources. Because the Proposed Action would affect each resource differently, the geographic scope for each resource may vary.

#### 3.2.1.1 Water Quantity

The storage and release of water for power generation and flood storage at the Baker River Project affects flows in the mainstem Skagit River below the confluence of the Baker and Skagit Rivers.

Under existing conditions, on a seasonal basis, project operations tend to augment mainstem Skagit River flows from August through March when there is typically a net removal of water from project's reservoirs. Conversely, there is a net storage of water from April through July which results in reduced flows to the Skagit River compared to unregulated Baker River conditions (refer to the discussion of surface water in section 3.3.2, Water Quantity).

Likewise under existing conditions, on a daily basis, Baker River Project load-following operations may cause fluctuations in mainstem Skagit River flows of up to 4,200 cfs over several hours each day. Stage differences between generating and non-generating periods may be between 0.9 feet and 1.2 feet as measured at the Skagit River near Concrete gage (Puget, 2002c).

Releases from the Skagit River Project operated by Seattle City Light also affect flows in the mainstem Skagit River. The Skagit River Project consists of three dams and associated reservoirs on the Upper Skagit River, with the most downstream powerhouse (Gorge) being situated at RM 94.2, about 38 river miles above the Baker/Skagit confluence. The Skagit River Project is typically operated as a load-following plant with the amplitude of Skagit River Project downramping events governed by the terms of a 1991 Fisheries Settlement Agreement (FERC, 1991). The effects of fluctuating releases at the Skagit River Project continue downstream but dampen in magnitude and are typically observed as river stage changes at the Skagit River near Concrete gage about 6 to 8 hours after the release occurs at the Skagit River Project.

The effects of both hydroelectric projects on river stage in the Skagit River near Concrete can amplify each other (be mutually additive) or somewhat offset each other (be mutually reductive). These interactive effects are largely attenuated by the time they reach the vicinity of Mt. Vernon at RM 15.7 (Puget, 2002c). Accordingly, the geographic scope of our cumulative effects analysis for river flows extends along the Skagit River from the Baker/Skagit confluence to Mt. Vernon.

#### 3.2.1.2 Water Quality

Water quality is influenced by human activities in the Baker River watershed including land management policies and recreation, current Baker River Project operations, the interaction of Baker River flows with flows from the Upper Skagit River, and increasing human development along the middle reach of the Skagit River. Accordingly, the geographic scope of our cumulative effects analysis for water quality extends along the Skagit River from the Baker/Skagit confluence to Sedro-Woolley at RM 24.5.

#### 3.2.1.3 Sediment Supply and Transport

Numerous human factors influence sediment supply to the Skagit River. Some of these tend to decrease sediment supply, while others tend to increase sediment supply. As described above, under existing conditions, project dams prevent bedload and most suspended load from passing the Lower Baker Development and entering the Skagit River. In a similar fashion, the Skagit River Project operated by Seattle City Light reduces sediment supply to the Upper Skagit River. In contrast, forest harvest practices and road building may increase sediment supply to Skagit River tributaries and consequently the Skagit River (Paulson, 1997).

Operation of the Baker and Skagit hydroelectric projects generally reduces flood flows and increases daily flow fluctuations (refer to the discussion of surface water in section 3.3.2, Water Quantity). Flood storage from both projects has reduced the sediment transport capacity of the Middle Skagit River. Without a large reduction in sediment supply, this reduction in sediment transport capacity would be expected to result in aggradation, particularly below large sediment sources. Although the Baker River Project has substantially reduced the sediment supply from the Baker River, there is no evidence that the in-channel sediment deposits have substantially decreased (R2, 2004). In fact, recent reassessment of cross-sections and water surface elevations downstream of the Skagit River near Concrete gage suggests that the reach has aggraded over the last several decades (Corps, unpublished data, as cited in R2, 2004). Surveys of transects located downstream of Sedro-Woolley suggest that the Lower Skagit River has aggraded by 1 to 2 feet since the 1970s.

The geographic scope of our cumulative effects analysis for sediment supply and transport is the Baker River watershed and the Skagit River from the Baker/Skagit confluence downstream to Sedro-Woolley.

#### 3.2.1.4 Aquatic Resources

**Anadromous Fish Populations**

Reservoir operations, fish passage, habitat modifications, fish propagation and enhancement programs, and flow regimes in both the Baker and Skagit Rivers affect

anadromous fish populations. Many of the anadromous salmonids inhabiting the Baker River watershed are considered to be components of Skagit River stocks. For example, fall Chinook entering the Baker River adult trap are considered to be part of the Lower Skagit mainstem/tributaries fall Chinook stock, while chum migrating to Baker River are part of the mainstem Skagit fall chum stock (WDFW and Western Washington Treaty Indian Tribes [WWTIT], 1994). Therefore, potential effects on fisheries resources caused by the Baker River Project could cumulatively affect Skagit River salmonid stocks when considered with other actions in the watershed that may affect those fish stocks.

Furthermore, anadromous fish migrating to the Baker River may also be cumulatively affected by non-related actions occurring in the Baker River watershed and in the Skagit River from the Baker/Skagit confluence downstream to the Skagit River estuary. Non-related actions that result in degradation of aquatic habitat in the Middle and Lower Skagit River or the Baker River watershed may cumulatively affect Baker River fisheries resources.

Recovery efforts also have been initiated for ESA-listed Puget Sound Chinook salmon populations. Activities associated with such efforts that improve aquatic habitat, productivity, and/or survival of Chinook salmon in the Puget Sound evolutionarily significant unit (ESU) may also produce a cumulative benefit for Baker River fish populations when considered with other efforts to improve fisheries resources in the basin.

Considering these potential sources of cumulative effects on fisheries resources, the geographic scope of our cumulative effects analysis includes the Baker River watershed and the Skagit River from the confluence with the Baker River downstream to the Skagit River estuary. To a lesser extent, our analysis will discuss potential cumulative effects on Puget Sound fisheries as they relate to current recovery efforts.

**Resident Fish Populations**

Reservoir operations, fish passage, habitat modifications, fish propagation and enhancement programs, and flow regimes in both the Baker and Skagit Rivers may also affect resident fish populations. Project operations (e.g., flow regime and reservoir fluctuations) can affect the spawning and rearing habitat potential of resident fish species in both the Baker and Skagit Rivers. These project-related influences when considered with non-project activities, such as potential timber harvest activities, recreational development, residential and commercial development, fish harvest, and other reasonably foreseeable human activities, could cumulatively affect Baker and Skagit River resident fish species. Considering these factors, the geographic scope for our cumulative effects analysis for resident fish includes the Baker River and tributaries up to migration barriers and the Skagit River from the Baker/Skagit confluence downstream to Mt. Vernon.

#### 3.2.1.5 Terrestrial Resources

Past actions from a variety of sources, including recreation, project construction and operation, and other human activities in the watershed like timber harvesting have cumulatively affected certain wildlife habitats in the Baker River basin. Key habitats cumulatively affected include mature and old-growth coniferous forest, deciduous forest, riparian habitats, and wetlands. Additionally, on the basis of scoping comments, we consider cumulative effects on rare plants. The geographic scope of our cumulative effects analysis for wildlife habitat is the Baker River watershed.

#### 3.2.1.6 Recreational Resources

Construction of the Baker River Project has contributed to the cumulative increase in developed recreational facilities within the Baker River watershed. Historically, the first trails in the watershed were hunting and gathering trails developed by Native Americans. Homesteaders in the region added to these trails as did loggers. Early mountain climbers used these early trails when attempting to climb Mt. Baker and Mt. Shuksan. In the late 1890s, a fish hatchery was constructed on the south side of Baker Lake. The development of the Lower Baker dam in 1925 led to more roads in the watershed allowing people easier access above Lake Shannon to the old Baker Lake and the surrounding high country. The creation of Baker Lake reservoir increased the amount of lakeside recreational opportunities in the watershed, and increasing numbers of recreationists spurred the development of recreational facilities and trails. Accordingly, the geographic scope of our cumulative analysis for recreation is the Baker River watershed.

#### 3.2.1.7 Cultural Resources

Past actions from a variety of sources, including recreation, project construction and operation, the Skagit River Project, and other human activities in the Baker River watershed have cumulatively affected prehistoric and historic archaeological resources and culturally sensitive areas associated with the Upper Skagit Indian Tribe, the Sauk-Suiattle Indian Tribe, and the Swinomish Indian Tribal Community, as well as historic structures and buildings associated with hydroelectric development in northwest Washington State. Key cumulatively affected resources include the cultural materials associated with sites used by the tribes and the hydroelectric facilities. The geographic scope of our cumulative effects analysis for cultural resources is the Baker River watershed.

### 3.2.2 Temporal Scope

Based on the anticipated term of any new license issued for the Baker River Project, we will look 30 to 50 years into the future, concentrating on the cumulative effects of relicensing the project on instream flows, water quality, sediment supply and

transport, anadromous fish, resident fish, wildlife habitat, recreation, and cultural resources in the context of past, present, and reasonably foreseeable future actions.

## 3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

### 3.3.1 Geology and Soils

#### 3.3.1.1 Affected Environment

**Geology**

The Baker River basin's geology is the product of mountain building over millions of years through uplift, folding, and volcanism.[17] The current landforms have been sculpted by repeated glaciation and stream erosion. Alpine glaciation has produced the sharp peaks and ridges, as well as cut the deep valleys. Continental glaciation has rounded many of the landforms at lower elevations and scoured out the pre-existing drainages. These glaciers also created ice dams behind which large glacial lakes were formed, and into which heavily sediment-laden streams deposited their alluvium.

The post-glacial history is responsible for much of the geological complexity associated with the Upper Baker dam area. With the retreat of the Vashon Glacier about 15,000 years ago, the Baker River was left in a deeply glaciated valley about 400 to 500 feet deeper (at the dam site) than the current ground elevation. A series of eruptive events along the flanks of Mt. Baker produced a sequence of mudflows, pyroclastic flows, and lava flows down the tributary valleys draining the mountain. In the Baker River valley, the most extensive of these occurred in the pre-existing Sulphur Creek and Boulder Creek valleys. In the Sulphur Creek valley, one or more lava flows originating from a vent at Schreiber's Meadow extended about eight miles down the valley and forced the Baker River against the eastern side of its valley and dammed the river temporarily. Based on stratigraphic data, this event took place after a major tephra eruption dated at 10,350 years ago and before the layer of ash that was deposited from the eruption of Mt. Mazama dating from 6,600 years ago. As a result, the current channel of the Baker River was downcut east of Glover Mountain rather than to the west, where the ancestral channel is now buried under many hundreds of feet of lava.

Lava from the vent at Schreiber's Meadow filled the valley of Sulphur Creek to a depth of up to 800 feet and, as it entered the Baker River valley, spread out upriver and pushed Sandy Creek to the northern side of its valley. Subsequent to this lava flow, mudflows, alluvium, and colluvium have filled in the pre-existing drainages to significant depths.

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[17] The description of geology, soils, and geological hazards comes from Puget (2002b), except where noted.

**Soils**

The soils of the watershed fall into one of two general classifications: alluvial soils or upland soils. The deeper and more fertile alluvial soils are associated with the floodplains of major watercourses, such as the Baker River and Lower Swift Creek. The upland soils are characteristically shallow, low in fertility, and found on steep slopes. Typically, they are derived from glacial materials, although they can also be shallow, gravelly, or residual soils derived from the local bedrock.

Snyder and Wade (1970, as cited by Puget, 2002b) identified five major soil groups based on similarities in texture, structure, soil depth, and mode or origins in the reference soil resource inventory titled "Mt. Baker National Forest Soil Resource Inventory." All five of these soil groups are present in the Baker River basin.

The most prevalent category of soil in the Baker River basin is that of the high-elevation soils. These are the thin, intermittent soils formed on rocky outcrops, talus slopes, alpine meadows, and around snow and ice. These soils are both shallow and fragile, and they are easily eroded if the vegetation is removed. These soils occur above the timberline throughout the watershed. Alpine vegetation clinging to them is easily destroyed by even light foot traffic.

Soils categorized as shallow residual soils and deep glacial soils found on long steep slopes, ridges, and narrow valleys are the second most common in the watershed and generally occur at elevations above 1,000 feet. The shallow residual soils typically predominate at elevations above 3,000 feet to the tree line, while the deeper glacially derived soils occur more generally at lower elevations. The combination of weakly structured soils, high slopes, and heavy precipitation results in a high potential for surface erosion of the residual soils.

Less frequently encountered are the more localized, deep, unstable colluvial soils originating on steep toeslopes and midslopes. The hillside between Ermine and Noisy Creeks on the east bank of Baker Lake is one of the best examples of these types of soils in the watershed. These soils generally consist of gravel or silt and sandy loam with subsoil textures of clay, gravel, and sand. When combined with steep slopes, weathered bedrock, and saturated subsoils, these areas are prone to slump even under undisturbed conditions.

Another major category is the deep, stable soils derived from glacial till and outwash deposits. These soil types are characteristic of the Baker River valley floor, from about Blum Creek downstream to Upper Baker dam, and the valley of lower Swift Creek as well. Most of this soil mapping unit has been inundated by the Upper Baker reservoir.

The final category of soils is the deep, unstable soils derived from glacial lake sediments, till, and outwash. In the Baker River basin, these soils occur downstream of the upper dam along the valley floor where they have been deeply incised by the Baker River. They also occur in combination with deep, unstable colluvial soils associated with the steep sideslopes of the Lower Baker River canyon.

**Geologic Hazards**

Potential geologic hazards in the Baker River basin include volcanic activity from Mt. Baker or the more general risk of earthquakes.

The northern Cascades are underlain by a number of major fault zones. Extensive geologic investigations have been conducted to identify the major fault zones closest to project developments and to determine if any of these faults show signs of renewed activity (Coombs, 1989, as cited by Puget, 2002b). The following were investigated for signs of recent movement: the Straight Creek Fault, which runs north-south about 25 miles east of the Lower Baker River valley until it is cut off by the intrusive rocks of the Chilliwack Batholith; the southern edge of the Chilliwack Batholith about 20 miles east of Upper Baker Development; a series of scarps south of the batholith that were suggestive of a major fault zone; and the Shuksan Thrust. Tephrochronology (using known volcanic eruptions to date sediment layers) confirmed that neither the scarps nor the southern edge of the batholith had experienced any movement over the last 6,600 years, and there was no evidence that either the Shuksan Thrust or the Straight Creek Fault had experienced any movement over a much longer period (refer to Forest Service (2002a) for a detailed discussion about faulting and seismic potential).

The hazards posed by Mt. Baker were examined in considerable detail following the most recent increase in hydrothermal activity in Sherman Crater, which lies about 0.5 mile south of the summit (Hyde and Crandell, 1978, as cited by Puget, 2002b). This increased activity was monitored very closely in 1975–1976 when it peaked, but it has subsided to normal background conditions since that time. Hyde and Crandell (1978, as cited by Puget, 2002b) identified the four principal classes of volcanic hazards as the formation of mud flows and avalanches, the eruption of tephra, hot pyroclastic flows, and lava flows. An eruption often produces hazards in more than one class simultaneously.

With the exception of the emission of tephra, the direct effects from the other volcanic activity classes would occur in the tributary drainages radiating from Mt. Baker and the Baker River valley from the mouth of Rocky Creek to the upper end of Baker Lake (refer to Forest Service (2002a) page 3-71, figure 3-17, Volcanic Hazard Areas). Secondary effects, such as forest fires or the flooding accompanying the sudden melting of large quantities of snow and ice, could result in effects both upstream and downstream of this area. The magnitude and extent of such effects would depend on wind direction and strength, antecedent snowfall accumulation, and seasonal reservoir water levels,

factors independent of operational alternatives considered in this analysis. Renewed thermal activity on Mt. Baker could create conditions for large mud flows originating from a mixture of snow, ice, melt water, and avalanches of structurally weak clay-rich rocks. A possible worst-case event could reach Baker Lake and displace 15 to 20 percent of the reservoir volume. In 1975, as a precautionary measure, in response to volcanic observations on Mt. Baker, Puget voluntarily dropped the water surface elevation in Baker Lake to about 710 feet msl (Puget, 2002b).

### Sediment Supply and Transport

Sediments are supplied to the Baker River system through one of three processes: (1) mass wasting, (2) surface erosion, and (3) soil creep. Mass wasting supplies most of the coarse-grained sediments, while also supplying fine-grained sediments. In contrast, surface erosion and soil creep provide mostly fine-grained sediments and virtually no coarse-grained sediments. Erosion of moraines and other sediments deposited by glaciers also supplies streams and the reservoirs with coarse and fine sediments. In addition, glacial melt provides a source of fine sediments. As glacial melt increases during summer, very fine sediments (i.e., glacial flour) become entrained in the water and lead to naturally elevated turbidity in some streams draining the northwest portion of the basin, particularly Swift, Park, Boulder, Sandy, and Rocky Creeks.

The most frequent and primary means of mass wasting at Mt. Baker are debris avalanches and debris flows (Gardner et. al., 1995). Debris avalanches and debris flows have moved down all of the drainages that have headwaters on Mt. Baker. Since 1958, at least six debris avalanches have occurred on Mt. Baker, all of which originated in the Sherman Crater area (Gardner et. al., 1995). Many debris avalanches at Mt. Baker transform into debris flows. Debris flows of moderate size, 0.002–0.02 square mile, have occurred during both eruptive and non-eruptive periods and have traveled six to nine miles from the mountain's summit. Gardner et al. (1995) indicated that moderate-sized debris flows are of special concern in basins that have headwaters on the east and southeast sides of Mt. Baker, because events in these drainages could potentially reach Baker Lake.

Paulson (1999) developed estimates of natural and existing rates of hillslope sediment production. Sediment production rates were based on results of inventorying landslides based on two sets of aerial photographs (1983 and 1991), records of land use history, and literature values for glacial erosion rates. Estimates of natural and current sediment production rates were developed for each of four subbasins. Results of this analysis indicate that sediment production rates are relatively similar to natural conditions for the Baker Lake subbasins; however, land use has increased the sediment production rate in the Lake Shannon subbasin.

Paulson (1999) compared sediment production rates for immature forests and road-related landslides to rates for mature forests. For the Baker Lake subbasin (i.e.,

streams draining to Baker Lake with the exception of the Baker River, Swift Creek, and Park Creek), results of Paulson's investigation suggest that the sediment production rate from landslides in immature forests was 10 times higher and road-related landslides were 21 times higher than landslides in mature forests. Similarly, estimated rates were considerably higher in the Lake Shannon subbasin; immature forest rates were 19 times higher and road-related rates were 150 times higher than mature forest. This suggests that land-use activities within the Lake Shannon subbasin have substantially altered sediment supply to streams. A major landslide that mobilized about 250,000 cubic yards of material destroyed part of the Lower Baker powerhouse in May 1965. In 1990, another landslide mobilized about 250,000 cubic yards of sediment from Miner's Creek into Lake Shannon (Paulson, 1999). Both of these landslides occurred during major precipitation events. Sediments from the Miner's Creek landslide elevated turbidity in Lake Shannon, the Lower Baker River, and the Skagit River for three years (Forest Service, 2002a).

In addition to erosion occurring throughout the watershed, erosion occurs along the shorelines of project reservoirs. Shoreline erosion can be influenced by several natural factors including local geology, soil type, bank configuration, wind direction, wind speed, and stream currents. Shoreline erosion can also be influenced by several human-influenced factors including reservoir pool elevation, fluctuations in pool levels, and land use activities. Puget conducted an evaluation of shoreline erosion around Baker Lake and Lake Shannon using ortho-corrected aerial photographs taken in 2001 and spring 2002 reconnaissance level field surveys (Associated Earth Sciences, Inc. (AESI), 2003). Results of this evaluation indicate that the primary cause of erosion along the shoreline or in the drawdown zone was undercutting, either by wave or stream action, or a combination of both. Other erosion processes included bank toppling, slides and flows, rills and gullying, dry raveling, and ground water piping. AESI (2003) noted that generally two or more processes were affecting a given area.

AESI (2003) categorized the severity of erosion along the shorelines of Baker Lake and Lake Shannon into one of four categories. A summary of results from AESI (2003) is provided in table 3-1. Severe erosion (described as near-vertical bluffs of more than ten feet high) occurred along approximately 2.5 to 2.8 percent of each reservoir's surveyed shoreline. High erosion defined by near-vertical bluffs or bank undercutting of three to ten feet occurred along 8.5 percent of Baker Lake's surveyed shoreline and 11.5 percent of Lake Shannon's surveyed shoreline. The majority of the remaining shoreline had low to moderate erosion for Lake Shannon and was not eroding for Baker Lake.

Table 3-1. Shoreline erosion categorization around Baker Lake and Lake Shannon. (Source: AESI, 2003)

| Category | Category Description | Baker Lake Shoreline | Lake Shannon Shoreline |
|---|---|---|---|
| 1-Severe | Near-vertical bluff height >10 feet | 0.8 mile (2.5%) | 0.7 mile (2.8%) |
| 2-High | Near-vertical bluff height or undercutting of bank of 3–10 feet | 2.7 miles (8.5%) | 2.8 miles (11.5%) |
| 3-Low to moderate | Near-vertical bluff height or undercutting of bank measurable, but <3 feet | 11.8 miles (37.3%) | 17.0 miles (70.0%) |
| 4-Not eroding | No undercutting and no near-vertical exposed bluff[a] | 16.3 miles (51.6%) | 3.8 miles (15.6%) |

[a] Includes areas where bedrock is exposed along shoreline.

Site geology and slope were similar for sites categorized as having high or severe erosion. Over half of the Baker Lake shoreline sites categorized as such had coarse-grained outwash and alluvium exposed. The vertical to near-vertical pre-project terrace escarpments and Baker River cut banks were particularly susceptible to undercutting by wave action and streams. The most severe erosion areas occurred where outwash or alluvium was present on these steep slopes. Where coarse-grained outwash and alluvium were present on gentle slopes, wave action generally removed sand-sized particles, leaving behind a gravel lag deposit. At Lake Shannon, the majority of erosion sites that have high or severe erosion occur in steep-sloped areas with thick deposits of glaciolacustrine silt/clay with larger size sediments and dropstones, incorporated. Most (25 of 29) shoreline erosion sites categorized as high or severe erosion were located on promontories that are heavily affected by wave erosion.

The majority of both reservoirs' shoreline sites that were categorized as having low to moderate erosion included long stretches of shoreline where undercutting had occurred, generally less than two feet. Stumps immediately adjacent to the shoreline had between one and three feet of roots exposed. Rill and gully erosion along with wave erosion are the predominant erosion processes in these areas.

During the spring of 2002, Puget evaluated erosion in the drawdown zones of Baker Lake and Lake Shannon. This study focused on erosion that was non-cyclic in nature. No severe erosion sites were identified in the drawdown zone evaluated; however, 19 drawdown-zone sites in the two reservoirs were categorized as high erosion sites. Baker Lake had 17 high erosion sites and Lake Shannon had two high erosion sites (AESI, 2003). Nearly all of the drawdown-zone erosion sites identified in Baker Lake occur along the edge of flat terraced areas on the western side of the reservoir and may have been caused by wave action. Similarly, wave action against the edge of a gently

sloping terrace located just up-reservoir of the Bear Creek confluence with Lake Shannon could be responsible for high erosion in this area.

The edges of most of these terraces where the high erosion sites were identified were at elevations of about 705 to 710 feet msl for Baker Lake and about 420 feet msl for Lake Shannon.

As sediment is transported into the project's reservoirs, water velocities decrease rapidly, and consequently much of the sediment drops out of the water column. The reduced rate at which sediment is transported is highly dependent on the flow and size of the sediment. The larger-sized sediments drop out first, followed by finer sediments farther down reservoir. Finer-sized suspended sediments continue farthest down reservoir, sometimes continuing completely through the reservoir depending on water velocities and sediment size. Evaluation of Upper Baker Delta substrate characteristics indicates that storm events result in widespread deposition and lateral shifting of the primary distributary channels through the delta (R2, 2004b). Annual drawdown of the reservoirs mobilizes a portion of the deposited sediments. Results of monitoring bed profiles at the Upper Baker Delta indicate that drawdown of Baker Lake causes vertical incision of the delta in the channel braids located at the transition from riverine to reservoir conditions (R2, 2004b). However, virtually none of the coarse-grained sediments are transported past either the Upper or Lower Baker dams. Instead, reservoir drawdown causes sediments to be re-sorted and resuspended, depending on sediment size (R2, 2004a). Unequalized pore pressures during drawdown may also increase the risk of mass wasting along the shoreline, particularly in areas with glacial lake sediments (Heller, 1978, as cited in Forest Service, 2002a; Esser, 1999).

R2 (2004a) evaluated the potential for the two reservoirs and natural Baker Lake, which was inundated by the Upper Baker dam, to interrupt sediment transport downstream of the project. This was done by first estimating the sediment supply from three subbasins and then estimating the trapping efficiencies of the reservoirs. First, R2 estimated the bedload yield based on bedload rating curves developed from field data for tributary streams in the Baker River basin. Second, it estimated suspended sediment yield by using long-term water quality data collected for the Nooksack River, which drains the northern and western flanks of Mt. Baker. Then, the total load was estimated from each of these estimates by assuming that bedload accounted for 15 percent of the total annual sediment load. The resulting estimates were compared to published regional estimates of bedload yield. R2 used the modified Brune Curve method, which uses the ratio of reservoir capacity to mean annual water inflow, to estimate the fraction of the sediment that is trapped in the impoundment (Linsley et al., 1982). To evaluate trap efficiencies for sediment size classes ranging from very fine clay to small cobbles, R2 used a method that the U.S. Bureau of Reclamation recommends for turbulent flow that is based on reservoir hydraulic characteristics (Borland, 1971; Chen, 1975; and Raudkivi, 1993).

The results of these evaluations indicate that approximately 14 percent of suspended sediment entering Baker Lake is routed past the Upper Baker dam and into Lake Shannon. Approximately 33 percent of the suspended sediment entering Lake Shannon is routed past the Lower Baker dam and into the Lower Baker River. In comparison, approximately 29 percent of the suspended sediment entering natural Baker Lake would have been routed through this lake. Virtually all sediments larger than medium silt are trapped in Baker Lake and sediments larger than fine silt are trapped in Lake Shannon. Most sediment smaller than coarse clay passes through Baker Lake and Lake Shannon. The portion of sediments between these sizes that is trapped in the reservoirs is dependent on the water level of the reservoir and flows through the reservoir.

Sediment budgets for the project are displayed in table 3-2. In summary, about ten percent of sediments pass both project developments. Sediments supplied downstream of the Lower Baker Development average 28,700 to 42,100 tons per year, and no bedload.

Table 3-2. Sediment budgets for Baker River with the influence of the Baker River Project.

| **Location** | **Suspended Load** | **Bedload** | **Total Load** |
|---|---|---|---|
| **Sediment Supply (tons/year)** | | | |
| From Baker River and tributaries upstream of natural Baker Lake | 93,500–181,800 | 14,100–27,200 | 107,600–209,000 |
| From Baker Lake reservoir tributaries downstream of natural Baker Lake | 65,300–126,500 | 9,700–18,900 | 75,000–145,400 |
| From Lake Shannon tributaries[a] | 64,200–85,100 | 9,600–12,700 | 73,800–97,800 |
| **Percent of Incoming Sediment Trapped** | | | |
| In Baker Lake reservoir | 86% | 100% | 88% |
| In Lake Shannon[a,b] | 67% | 100% | 70% |

[a] Adapted from R2 (2004a).
[b] Based on incoming from Baker Lake reservoir and Lake Shannon tributaries not total incoming to basin above Lake Shannon.

The Baker River has two distinct sections below the Lower Baker dam. Between the Lower Baker dam and the weir at RM 0.6, the river flows through a narrow bedrock controlled canyon that has a high sediment transport potential with an armored layer consisting primarily of boulders and bedrock. The lowermost section of the river is much less confined, has a lower gradient than the canyon reach, is influenced by backwaters from the Skagit River, and has been straightened and dredged. Naturally, this reach was an alluvial fan where sediments routed through the canyon were deposited and reworked in the lower energy reach. Historically, there also was a side channel, the Little Baker

River, which meandered within the alluvial fan. The current straight incised channel has a higher potential to transport sediments and receives less sediments (due to deposition above the two dams), which has led to a coarse armor layer of bed sediments that remain stable even at high flows. High flows in the Skagit River result in backwater effects (i.e., reduced velocities and sediment transport capacity) in the lowermost section of the Baker River.

Operation of the Baker and Skagit hydroelectric projects generally affects Skagit River flows by reducing peak flood flows and increasing daily flow fluctuations (refer to the discussion of surface water in section 3.3.2, Water Quantity). Flood storage provided by both projects has reduced the sediment transport capacity of the Middle Skagit River. Without a large reduction in sediment supply, this reduction in sediment transport capacity would be expected to result in aggradation, particularly below large sediment sources. In fact, recent reassessment of cross-sections and water surface elevations downstream of the Skagit River near Concrete gage suggests that the reach has aggraded over the last several decades (Corps, unpublished data, as cited in R2, 2004a). Surveys of transects located downstream of Sedro-Woolley suggest that the Lower Skagit River has aggraded by one to two feet since the 1970s. Therefore, while the Baker River Project has substantially reduced the sediment supply from the Baker River, there is no evidence that in-channel sediment deposits have substantially decreased (R2, 2004a).

**Sediment Storage in Reservoirs**

Lower Baker dam began storing water and trapping sediment being supplied by the Baker River and its tributaries to Lake Shannon in 1925. Lake Shannon continued to trap sediment from all these sources until the Upper Baker dam was constructed in 1959. Since 1959, most of the sediments being transported by the Baker River above the Upper Baker dam have accumulated in Baker Lake, which has substantially reduced the rate of accumulation in Lake Shannon. Sediment trapped in Lake Shannon is primarily from tributary sources to Lake Shannon, not from sediment routed past the Upper Baker dam.

Puget's evaluation of the sediment budget (which does not include sediment supplied by reservoir shoreline erosion) indicates that currently average annual sediment accumulations are approximately 160,600 to 312,000 tons in Baker Lake and approximately 67,000 to 98,200 tons in Lake Shannon (R2, 2004a). Puget estimated that the total amount of sediment that has accumulated in the Baker Lake reservoir since the dam was constructed in 1959 is approximately 3,520 to 7,744 acre-feet, which accounts for about one to three percent of the total storage capacity of the reservoir. Estimated sediment accumulation in Lake Shannon since its construction in 1929 is between 3,526 and 5,624 acre-feet, which has reduced the storage capacity of the reservoir by about two to four percent.

Much of the sediment that accumulates in the reservoirs is deposited in deltas located just down-gradient of inflowing tributaries. The largest delta is the feature where the Baker River flows into the upper end of Baker Lake. Comparison of topographic data from 1959 and 1999 suggests that deposits within the drawdown zone on this feature are typically five to ten feet in thickness, although this is within the range of error associated with the data sets used. By assuming even distribution of all of the bedload and 60 percent of the suspended load, Puget estimated that deposits on the delta feature are 1.9 to 3.7 feet deep (R2, 2004a), which is reasonably consistent with estimates developed from the topographic data. Delta deposits are also present at the mouths of other glacially fed tributaries draining the east slopes of Mt. Baker. Comparison of 1959 and 1999 topographic profiles indicates that typically 5 to 15 feet of deposition has occurred in the drawdown zone of these deltas.

In Lake Shannon, sediment deposition is most obvious in the upper end of the reservoir and near the Thunder Creek confluence with the reservoir. Prior to construction of the Upper Baker dam, a considerable sediment load entered the reservoir from the Baker River and much of it was deposited at the upper end of the reservoir. Comparison of 1929 and 1959 storage capacity curves suggest that most sediments accumulated between roughly elevation 435 and 410 feet msl. Puget estimated that the depth of these sediments is probably about 9 to 19 feet (R2, 2004a). Thunder Creek is the only Lake Shannon tributary that has a pronounced delta feature. Coarse-grained sediment has completely filled in the original Thunder Creek embayment of the reservoir.

#### 3.3.1.2 Environmental Effects

**Reservoir Level Management**

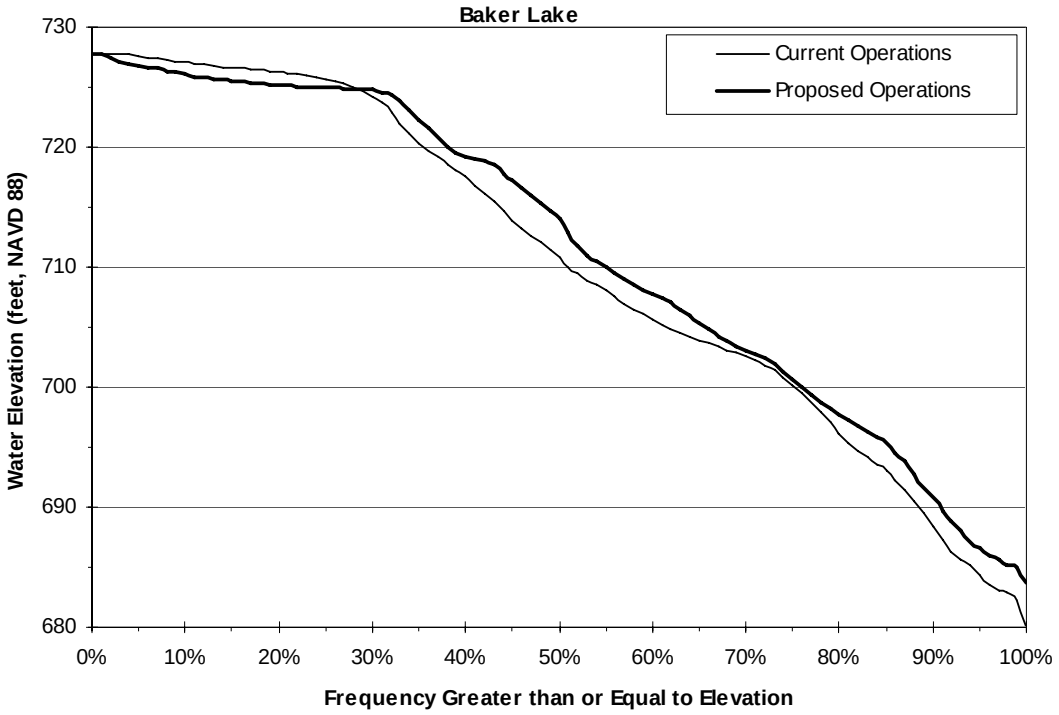
Erosion of sediments occurs along the shoreline and within the drawdown zone of both Baker Lake and Lake Shannon (AESI, 2003). The extent of shoreline erosion is influenced by natural factors including soil type, bank configuration, and wind direction. The extent of shoreline erosion is also influenced by human-controlled factors including reservoir pool levels, fluctuations in pool levels, land use activities, and recreational use. Recent evaluations indicate that approximately 11 percent of the Baker Lake shoreline and 14 percent of the Lake Shannon shoreline currently have “high” to “severe” erosion, as defined by AESI (refer to the sediment supply and transport discussion of Section 3.3.1, Geology and Soils, Affected Environment). Additional “high” erosion sites were identified in the drawdown zone of both reservoirs. Further, the drawdown of Baker Lake was determined to cause incision of the Upper Baker delta at the transition point from the river to the reservoir (Puget, 2003c).

*Effects Analysis*

Under the Proposed Article 106, for the first six years, Puget would make its best effort to limit downramp rates, limit daily amplitude changes, and minimize the difference between spawning and incubation flows. Limiting downramp rates and daily

amplitude changes would not result in significant changes in lake levels compared to current conditions. Although implementing best efforts to minimize the difference between spawning and incubation flows could shift the seasonal timing of releases and affect lake levels, significant changes in lake levels are not expected. Consequently, project operations under Proposed Article 106 for the first six years are not expected to effect ongoing shoreline erosion or ongoing erosion within the drawdown zones of either Baker Lake or Lake Shannon.

After the first six years (once the two new turbine-generator units are installed), Puget would operate the project in accordance with a Flow Implementation Plan and specifically, Aquatic Tables 1 or 2, required by Proposed Article 106. To evaluate any effects on shoreline erosion or erosion within the drawdown zones of either Baker Lake or Lake Shannon, Puget analyzed percent exceedance for water levels and daily water level fluctuations for Baker Lake and Lake Shannon. Results of the analysis of water elevations are displayed in figure 3-1, and results of the analysis of water level fluctuations are displayed in figure 3-2. These results are based on the HYDROPS optimization model used to evaluate flow and water level effects from project operations. An explanation of the HYDROPS model is contained in section 3.3.2, Water Quantity.



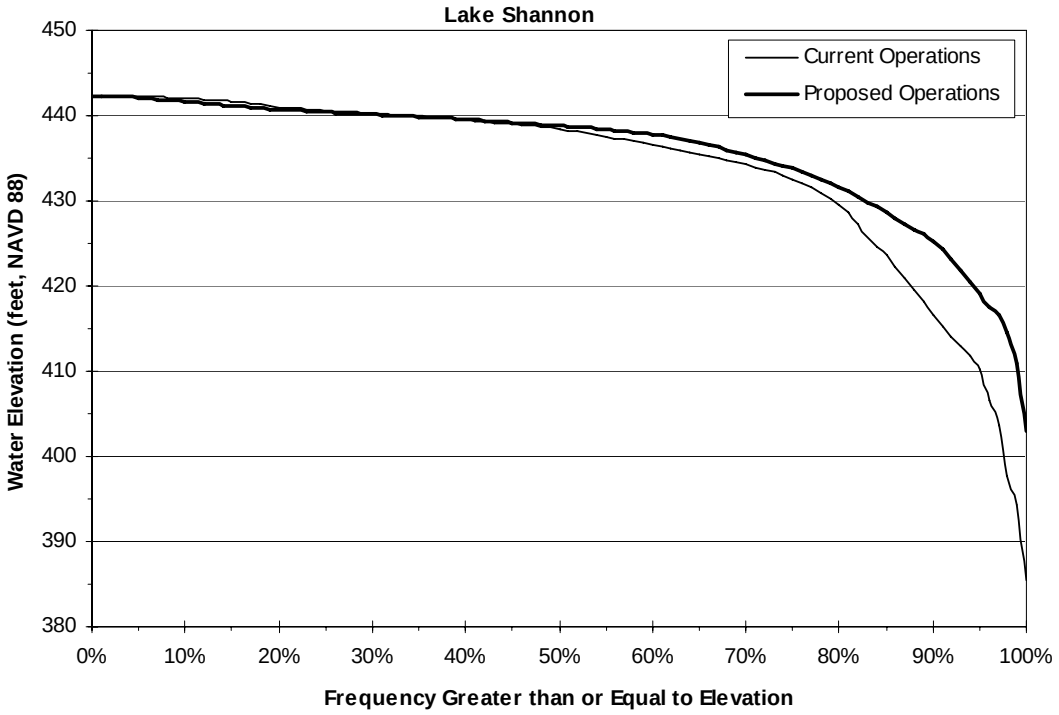
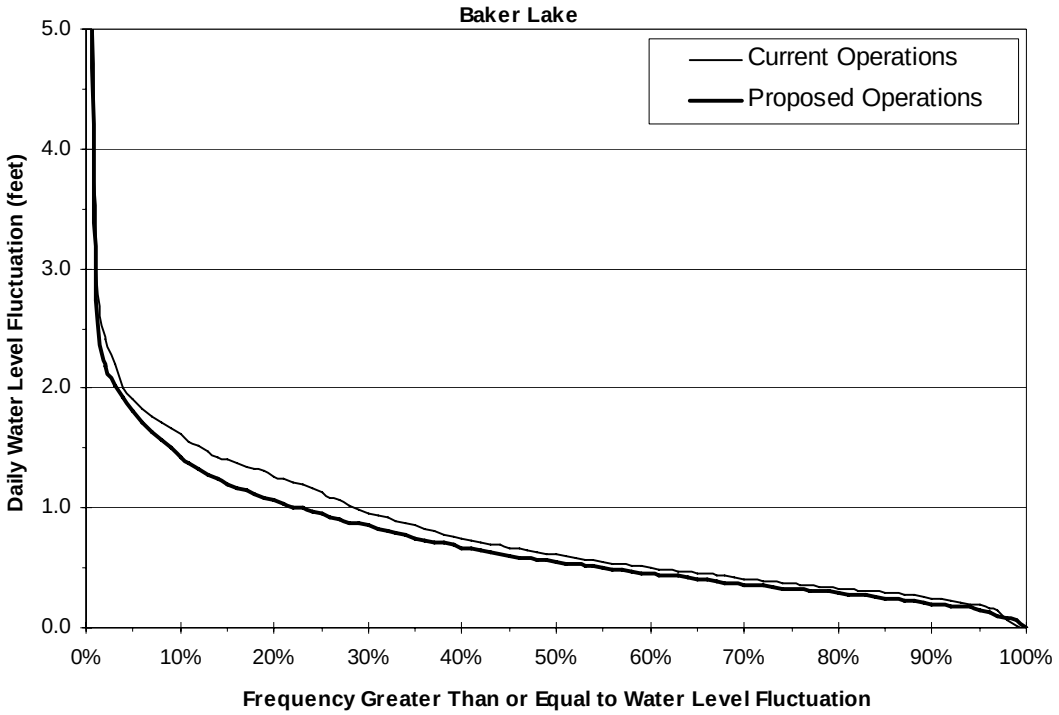




Figure 3-1. Duration analysis of modeled water elevations for Baker Lake and Lake Shannon based on HYDROPS results for five representative years.



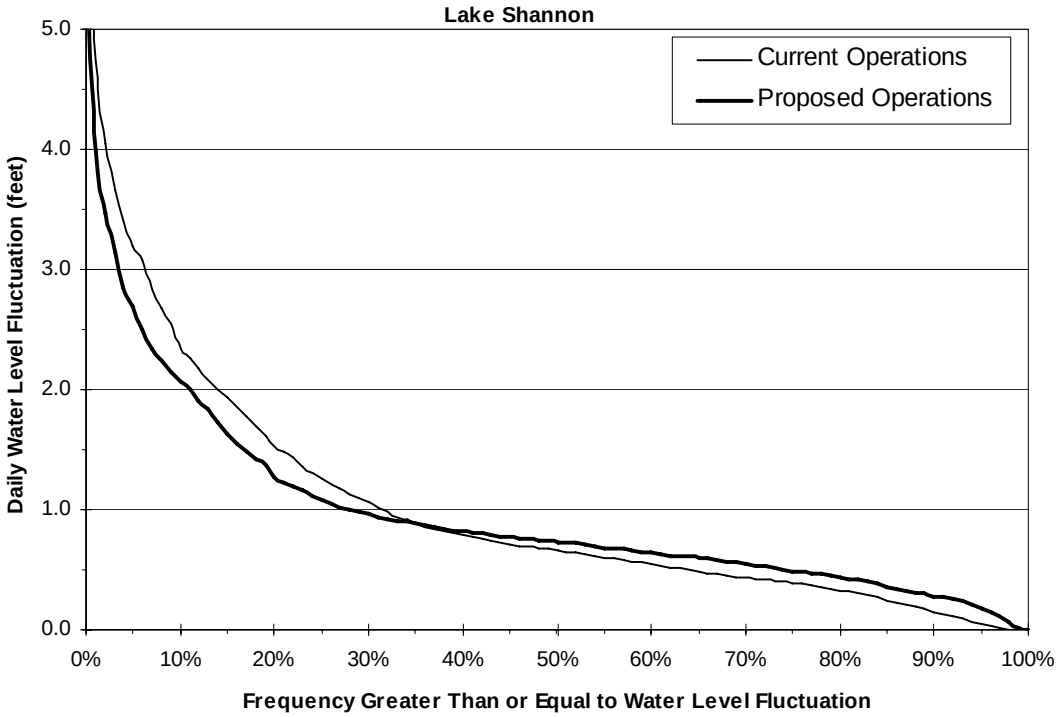




Figure 3-2. Duration analysis of modeled daily water elevation fluctuations for Baker Lake and Lake Shannon based on HYDROPS results for five representative years.

Operating the project under the Proposed Action would result in a similar range of Baker Lake water levels compared to current condition (figure 3-1). Baker Lake water levels would tend to remain higher than current levels approximately 70 percent of the time, although the modeled differential remained less than four feet (figure 3-1). The Proposed Action would result in little change in daily water level fluctuations (figure 3-2). Consequently, we have no basis to conclude that the modeled differences in water levels would affect ongoing shoreline erosion or ongoing erosion in the drawdown zone.

Implementation of the Proposed Action would result in Lake Shannon water levels that are higher than current conditions a little more than half the time (figure 3-1), and would somewhat reduce the frequency of daily water level fluctuations in the one to five-foot range (figure 3-2). Reduced lake level fluctuations in this range could somewhat reduce ongoing erosion along project shorelines.

Proposed Article 110 would require Puget to develop a Reservoir Shoreline Erosion Control Plan (Erosion Control Plan). Under this plan, Puget would evaluate individual eroding sites, propose site-specific treatment measures, prioritize sites for treatment, monitor treated and untreated sites, and update the plan every five years. This plan would ensure that ongoing shoreline erosion and ongoing erosion in drawdown areas are addressed. Any additional effects from operating the project pursuant to the Settlement Agreement would also be addressed. We discuss the effects of project operations on turbidities in section 3.3.3, Water Quality.

**Sediment Transport**

The downstream movement of most sediment, including all bedload (gravel and larger-sized sediments) is blocked by the Upper and Lower Baker dams. Currently, only a small portion of the Baker River's suspended sediment load passes the project. Most of this material is smaller than fine silt.

Despite the fact that the project acts as a sediment trap, available evidence suggests that the Middle Skagit River is currently aggrading. The aggradation may be the natural result of geomorphic processes and/or accelerated yields from tributary streams as a result of land management activities, the reduction in transport capacity caused by flood control at the Baker and Skagit projects, or a combination of these, or other factors.

Proposed Article 108 would require Puget to develop a Gravel Management Plan for evaluating sediment interruption by the Project and identifying any gravel augmentation measures to be implemented by Puget. Puget would develop the Gravel Management Plan in consultation with the Aquatic Resources Group (ARG) and file it along with documentation of consultation, comments and recommendations on this plan, and reasons for not accepting recommendations that it does not adopt. The Gravel

Management Plan would focus on improving the geomorphic function of the Lower Baker River alluvial fan and the project-affected downstream reach of the Skagit River. The fan landform is defined as the mainstem river channel and the associated depositional feature located within the Skagit River floodplain. This plan would include, at a minimum:

- A description of intended gravel augmentation that may address location and contribution of gravel/cobble-sized material in the affected reach, condition and substrate attrition rates in the reach immediately upstream, substrate change rates within the affected reach, and the relationship between substrate sizes and biological needs of salmonids and other aquatic organisms. The amount of gravel augmentation would not exceed 12,500 tons annually, which is the estimated amount of bedload intercepted by the project.
- Procedures for conducting cost-effective monitoring and evaluations of conditions in the Skagit River to determine any need for gravel augmentation and to track long-term trends in substrate profile degradation.
- Implementation guidelines and triggers for gravel/cobble augmentation that may include the condition of the Middle Skagit River, fluvial geomorphic changes throughout the term of any new license issued, and/or habitat suitability for salmonids or other aquatic organisms using the Middle Skagit River.

*Effects Analysis*

Project reservoirs act as sediment traps, preventing all bedload and most sediment from reaching the Skagit River. R2 (2004a) estimates that the project reduces the sediment supply to the Skagit River by approximately 6.5 percent. Despite these effects, there is no evidence that in-channel sediment deposits have substantially decreased in the Skagit River downstream of the Baker River confluence. Available evidence suggests that the Middle Skagit River is currently aggrading and surveys of transects located downstream of Sedro-Woolley suggest that the Lower Skagit River has aggraded by one to two feet since the 1970s.

Proposed Article 108 would require Puget to develop a Gravel Management Plan with two main purposes. First, Puget would complete its evaluation of augmenting gravel just below the project at the Lower Baker River alluvial fan which was begun in relicensing study A-16 (R2, 2004c). Adding gravel to the river would improve spawning conditions for Chinook salmon. Second, Puget would monitor the Skagit River downstream of the project on a long-term basis to determine if and when gravel augmentation ever becomes needed. Such augmentation is not needed at this time but could be needed later if aggradation stops. Criteria for beginning any gravel augmentation work in the Skagit River (below the Baker River alluvial fan) would be

included in the Gravel Management Plan. Puget's Gravel Management Plan in Proposed Article 108 would enhance spawning conditions for Chinook salmon and possible other fish species in the Lower Baker River. Further, any gravel augmentation in the Skagit River, if determined needed based on long-term monitoring, would also enhance salmonid spawning and mitigate bedload losses caused by the project.

#### 3.3.1.3 Unavoidable Adverse Effects

Lake level fluctuations would continue to cause some shoreline erosion and project reservoirs would continue to trap bedload and sediment from moving downstream. Installation of shoreline stabilization measures, the construction of new trails and other various recreation improvements have the potential for unavoidable, localized increases in erosion.

#### 3.3.1.4 Cumulative Effects

The Skagit and Baker hydroelectric projects substantially reduce sediment supply to the Skagit River. The dams block virtually all of the bedload supplied by the basins upstream of each project. Despite these effects, there is no evidence that in-channel sediment deposits have substantially decreased in the Skagit River downstream of the Baker River confluence.

Road construction and land management activities have increased the sediment supply from many tributaries to the Skagit River. As a result, the Skagit Watershed Council set a high priority on sediment reduction in unregulated tributaries (Beamer et al., 2000). Successful implementation of sediment-reduction projects is expected to reduce fine sediment supplied to the Skagit River during any new license term.

The Skagit and Baker hydroelectric projects have substantially reduced the Skagit River's sediment transport capacity through flood storage. Continued operation of the Skagit and Baker projects would continue these effects.

### 3.3.2 Water Quantity

#### 3.3.2.1 Affected Environment

**Surface Water Flows**

**Baker River—**The Baker River has a drainage area of approximately 297 square miles and contributes approximately 18 percent of the Skagit River's flow on an average annual basis as measured at the Skagit River near Concrete gage (R2, 2003a). Streamflows in the Baker River basin are driven by rainfall, snow, and glacial melt, and to a lesser extent, groundwater discharge to the stream channel. Using USGS gage data, the proportion of flow that the Baker River contributes to the Skagit River varies under different water year types. The Baker River generally contributes the greatest proportion

of flow during August to November, and the smallest proportion of flow during April and May. In an average year (1995), the Baker River contributed between 11 percent (April) and 27 percent (November) to the Skagit River downstream of the Baker River confluence.

Average annual runoff in the Baker River basin is about 120 inches, and varies from about 83 inches (USGS gage No. 12192700, Thunder Creek near Concrete) to 158 inches (USGS gage No. 12190718, Swift Creek near Concrete).

Glaciers in the headwaters of streams in the northwestern part of the Baker River basin substantially affect flows during the low-flow period. Pelto and Hartzell (undated) report that glacial melt accounts for 16 percent of the Baker River flow to the Skagit River between July 1 and October 1. This percentage is higher during dry, warm periods. Glacial melt accounted for 45 percent of the Baker River's outflow during the drought months of 1998. Between 1979 and 1997, glaciers in the basin retreated, and further glacial recession could reduce summer runoff and increase spring runoff from headwater streams.

Most of the tributaries to the Baker River are unregulated; however, the Koma Kulshan Hydroelectric Project (FERC No. 3239), which began operation in 1990, diverts up to 120 cfs of flow from Sulphur and Rocky Creeks (tributaries to Lake Shannon) to Sandy Creek (a tributary to Baker Lake).

Flows monitored at the Baker River near Concrete gage reflect the project's influence on flow patterns. This gage can experience a backwater effect from high flows in the Skagit River (70,000 cfs and greater at the Skagit River near Concrete gage) depending on flow in the Baker River. The reported gage data present existing (regulated) conditions; Puget estimated unregulated flows by removing the storage effects of Baker Lake and Lake Shannon. Summaries of both regulated and unregulated (i.e., adjusted for storage) daily mean, maximum 3-day maximum, and minimum 7-day low flows are presented in tables 3-3, 3-4, and 3-5, respectively.[18]

[18] Operation of the Project evolved during the late 1970s to early 1980s and has remained relatively stable since that time. Accordingly, water years 1981 through 2002 are used to represent flows under existing operating conditions.

Table 3-3. Daily mean statistics (cfs) for Baker River at Concrete under regulated and unregulated conditions (water years 1981 through 2002).[a]

| | Unregulated[b] | | | Regulated | | |
|---|---|---|---|---|---|---|
| **Period** | **Minimum** | **Median** | **Maximum** | **Minimum** | **Median** | **Maximum** |
| October | 456 | 1,369 | 18,609 | 95 | 2,805 | 19,200 |
| November | 484 | 2,366 | 38,418 | 95 | 3,930 | 21,500 |
| December | 573 | 1,753 | 32,485 | 82 | 3,010 | 19,000 |
| January | 428 | 1,841 | 29,853 | 80 | 2,970 | 14,100 |
| February | 279 | 1,721 | 19,592 | 80 | 2,850 | 5,960 |
| March | 366 | 1,659 | 27,206 | 47 | 2,660 | 4,100 |
| April | 371 | 2,095 | 14,475 | 30 | 1,820 | 9,990 |
| May | 869 | 3,084 | 15,402 | 56 | 2,850 | 5,040 |
| June | 1,575 | 3,709 | 12,311 | 91 | 3,660 | 13,500 |
| July | 1,170 | 2,826 | 20,427 | 95 | 2,945 | 21,000 |
| August | 591 | 1,662 | 10,675 | 66 | 2,030 | 7,080 |
| September | 577 | 1,190 | 9,165 | 66 | 1,780 | 5,120 |

[a] Water data for 2002 are based on provisional data collected by Puget in 2002. Some values were rounded in accordance with USGS standard practices in the final data published in Kimbrough et al. (2003). The difference amounts to 1 cfs on any given day and does not materially affect the long-term statistics.

[b] Unregulated flows were computed by correcting for changes in storage of Baker Lake and Lake Shannon.

Table 3-4. Maximum 3-day maximum flow statistics (cfs) for Baker River at Concrete under regulated and unregulated conditions (water years 1981 through 2002).[a]

| | Unregulated[b] | | | Regulated | | |
|---|---|---|---|---|---|---|
| **Period** | **Minimum** | **Median** | **Maximum** | **Minimum** | **Median** | **Maximum** |
| October | 950 | 5,299 | 12,134 | 1,549 | 3,898 | 11,567 |
| November | 2,000 | 7,466 | 26,701 | 2,540 | 5,423 | 16,333 |
| December | 1,202 | 5,789 | 20,695 | 1,308 | 4,047 | 15,233 |
| January | 2,030 | 5,194 | 17,269 | 2,363 | 3,958 | 9,127 |
| February | 1,669 | 4,497 | 15,121 | 2,443 | 3,872 | 5,047 |
| March | 1,485 | 3,696 | 16,530 | 312 | 3,732 | 4,100 |
| April | 2,534 | 4,724 | 10,337 | 2,034 | 3,560 | 7,727 |
| May | 4,320 | 5,452 | 11,354 | 1,953 | 3,778 | 5,383 |
| June | 3,636 | 5,741 | 10,977 | 2,840 | 4,037 | 10,570 |
| July | 2,997 | 4,343 | 17,487 | 2,717 | 4,010 | 17,567[c] |
| August | 1,605 | 2,833 | 6,980 | 1,650 | 3,040 | 5,613 |
| September | 1,175 | 2,910 | 6,057 | 1,527 | 3,038 | 4,550 |

[a] Water data for 2002 are based on provisional data collected by Puget in 2002. Some values were rounded in accordance with USGS standard practices in the final data published in Kimbrough et al. (2003). The difference amounts to 1 cfs on any given day and does not materially affect the long-term statistics.

[b] Unregulated flows were computed by correcting for changes in storage of Baker Lake and Lake Shannon.

[c] From July 12 to 14, 1983, a storm event resulted in an atypical increase of the 3-day maximum flow to about 17,567 cfs, compared to an unregulated flow of about 13,321 cfs.

Table 3-5. Minimum 7-day low-flow statistics (cfs) for Baker River at Concrete under regulated and unregulated conditions (water years 1981 through 2002).[a]

| | Unregulated[b] | | | Regulated | | |
|---|---|---|---|---|---|---|
| **Period** | **Minimum** | **Median** | **Maximum** | **Minimum** | **Median** | **Maximum** |
| October | 476 | 800 | 2,212 | 175 | 1,164 | 2,856 |
| November | 525 | 1,370 | 2,707 | 736 | 2,361 | 4,011 |
| December | 741 | 1,107 | 2,103 | 176 | 1,526 | 3,526 |
| January | 543 | 1,155 | 1,760 | 115 | 1,535 | 3,726 |
| February | 607 | 1,125 | 2,219 | 151 | 1,473 | 3,724 |
| March | 585 | 1,178 | 1,735 | 49 | 857 | 3,759 |
| April | 893 | 1,506 | 2,333 | 32 | 120 | 2,549 |
| May | 1,350 | 2,131 | 3,216 | 79 | 1,259 | 3,106 |
| June | 2,010 | 2,909 | 4,487 | 93 | 2,193 | 4,013 |
| July | 1,391 | 2,118 | 4,556 | 125 | 1,693 | 3,720 |
| August | 885 | 1,243 | 2,325 | 90 | 1,216 | 3,283 |
| September | 622 | 894 | 1,178 | 90 | 893 | 1,425 |

[a] Water data for 2002 are based on provisional data collected by Puget in 2002. Some values were rounded in accordance with USGS standard practices in the final data published in Kimbrough et al. (2003). The difference amounts to 1 cfs on any given day and does not materially affect the long-term statistics.

[b] Unregulated flows were computed by correcting for changes in storage of Baker Lake and Lake Shannon.

Uunregulated flows are highest in May, June, and July, and lowest in September. Operation of the project generally increases daily mean flows during August to March because the project draws down the reservoirs and shifts runoff from peak flow events to later in the year, and it generally reduces daily mean flows in April and May as the reservoirs are refilled (table 3-3).

The project, under existing conditions, substantially reduces peak flow events. The highest daily mean flows for unregulated conditions occur from November to January (about 30,000 to 38,500 cfs), but are reduced by at least 13,700 cfs with the project (table 3-3). Similarly, maximum 3-day maximum flows in November to January are reduced substantially (approximately 5,500 to 10,500 cfs) by project operations (table 3-4).

The project, under existing conditions, also generally reduces annual 7-day low flows (table 3-5). Generally, project operations reduce 7-day low flows from April to July, increase 7-day low flows from October to February, and have minimal effect on 7-day low flows in August and September. Under regulated conditions, the annual 7-day low flow most frequently occurs during spring refill (i.e., from April to June), but it can occur during any month of the year. In contrast, unregulated 7-day low flows tend to occur in late summer to early fall or in the winter. In general, project operations cause greater interannual variation in 7-day low flows. The increased variability in 7-day low-

flow levels and the timing is primarily related to maintenance outages, which can restrict project outflows to 80 cfs for several consecutive days (R2, 2004d).

The Baker River Project is typically operated as a load-following facility. Flows in the Lower Baker River depend largely on the Lower Baker Development's single generating unit. This unit efficiently operates between 3,700 and 4,100 cfs at a head of 253 feet. At flows of less than about 75 percent of capacity, pressure differentials result in severe cavitation (Puget, 2002c). When the unit is shut down, 25 cfs is continually released through a bypass valve. In addition, about 55 cfs leaks through pressure relief holes in Lower Baker dam abutments to contribute to the flow in the Baker River below the dam, resulting in a flow of 80 cfs when the Lower Baker Development is off-line.

Load-following operations cause daily flow fluctuations in the Lower Baker River of up to 4,200 cfs. During late June through July (periods of peak sockeye adult migration), Puget typically generates power at the Lower Baker Development for four hours beginning at daylight to provide additional attraction for adult sockeye staging at the confluence of the Skagit and Baker Rivers (Puget, 2002c). Since 1978, Puget has implemented a voluntary restriction on the Lower Baker Development's downramp rate when Skagit River flows, as measured at the Skagit River near Concrete gage, are less than 18,000 cfs (Puget, 2002c). Following this protocol requires Puget to operate in the Lower Baker turbine's cavitation zone for about one hour during downramp events. Puget has had varying success in meeting the voluntary downramp rate.

**Skagit River—**Daily and hourly fluctuations of Skagit River flows depend on many different factors, including natural runoff from glacial and non-glacial streams and operations of the Skagit River and Baker River Projects. Figure 3-3 presents an example of the effects of current Baker River Project load-following operations and natural fluctuations on flows at the Skagit River near Concrete gage. The Skagit River Project was operated at relatively constant flows during this period (May 1998); therefore, this example does not show the effects of the Skagit River Project load-following operations. Since the water travel time from the Lower Baker Development to the Skagit River near Concrete gage is only about 30 minutes under typical generation flows, it closely reflects Baker River Project flow fluctuations without appreciable attenuation. Typical load-following operations at the Lower Baker Development cause the Skagit River to fluctuate up to 3,800 cfs on a daily basis (Puget, 2002c).

Snowmelt in the Upper Skagit River basin can result in substantial daily fluctuations in Skagit River flows. From May 1 to 7, 1998, naturally caused hourly flow fluctuations at the Skagit River near Concrete gage had about the same magnitude as effects from load-following operations at the Baker River Project, which occurred later in the month. During early May, neither the Baker River Project nor the Skagit River Project was operated as load following. Snowmelt produced diurnal flow fluctuations over a cycle of about 12 hours (refer to Sauk River in figure 3-3).

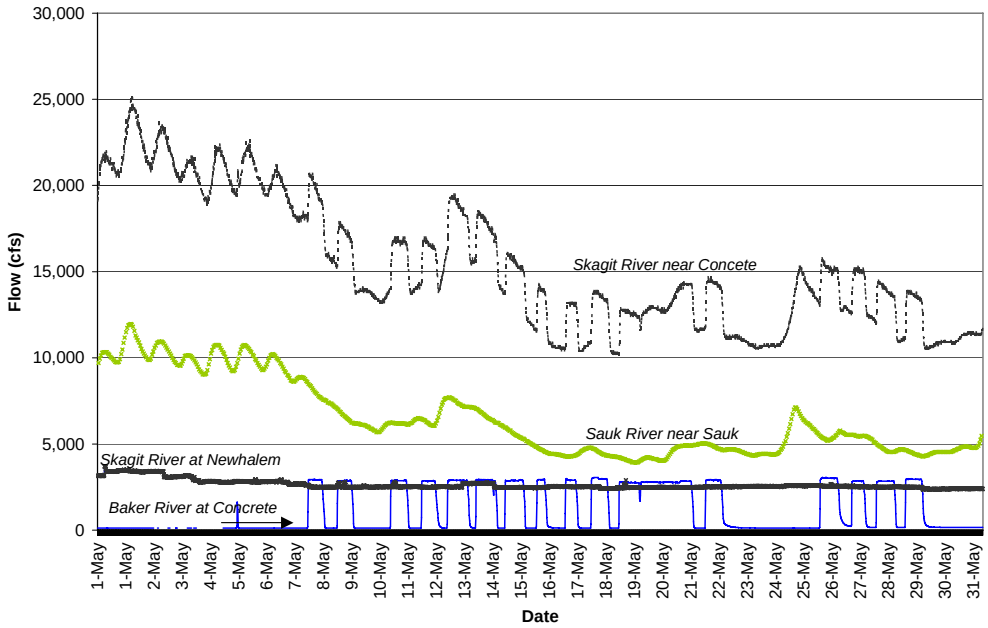



Figure 3-3. Example of the effect of current Baker River Project operations and natural diurnal fluctuations on May 1998 streamflow at the Skagit River near Concrete gage. Note that the Skagit River Project was not load following during this period. (Source: R2, 2004d)

Seattle City Light also typically operates its Skagit River Project in load-following mode. The Skagit River Project's lowermost facility is the Gorge powerhouse, which is approximately 40 miles upstream of the Baker River confluence. The Baker River and Skagit River projects often follow similar load-following regimes. R2 (2004d) reported that the magnitude of the Skagit River Project's ramping events ranged from 1,260 to 3,120 cfs in 1998 at the Skagit River near Concrete gage. Figure 3-4 displays an example of attenuation, lag time, and accumulation of water from other sources as water moves down the river to the Skagit River near Concrete gage. Substantial attenuation occurs upstream of this gage, which results in a slower rate of reduction (and an increase in upramping) of flows. It typically takes approximately six to eight hours for Skagit River Project outflows to reach the confluence with the Baker River. Under current Baker River and Skagit River project operations, load-following operations of the two projects can either amplify or somewhat offset flow fluctuations of each other (Puget, 2002c).

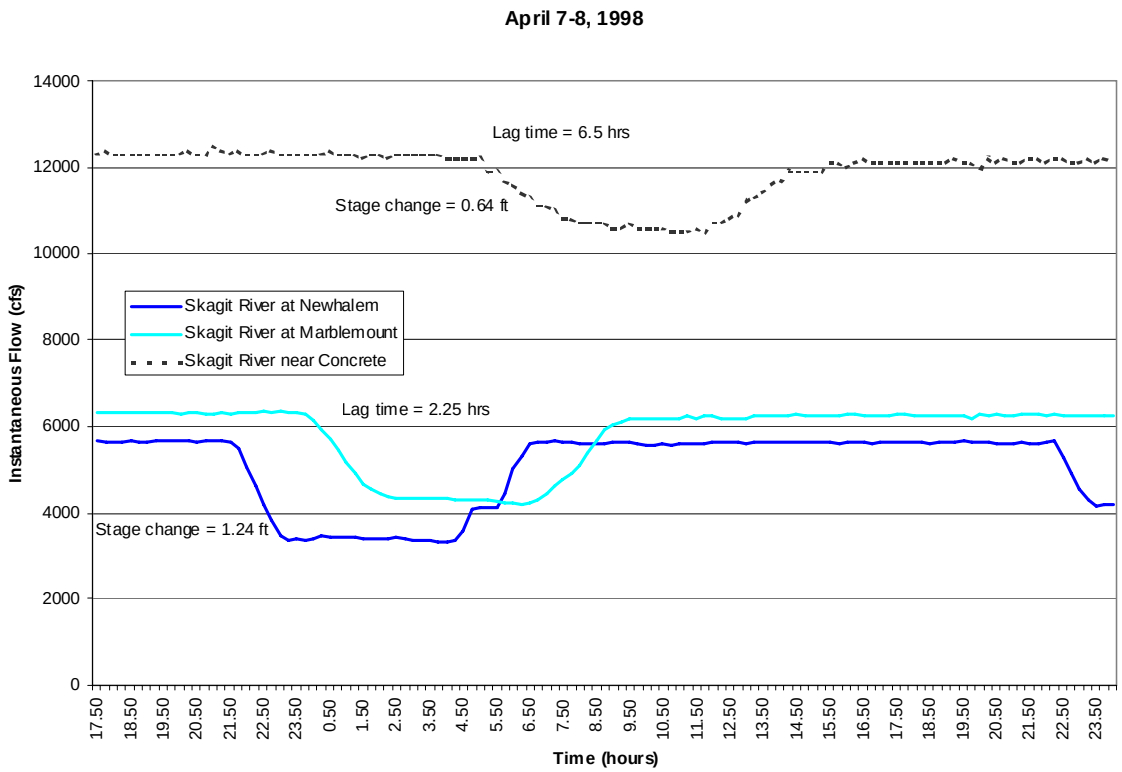



Figure 3-4. Example of attenuation and lag time upstream of the Skagit River near Concrete gage associated with a typical load-following event at Seattle City Light's Skagit River Project on April 7–8, 1998. (Source: R2, 2004d)

Flow regulation upstream of the Concrete gage helps reduce downstream flooding. Two major storm events occurred in October 2003, following the period that Puget evaluated to represent existing conditions. Forecasted peak inflows to Baker Lake for the two storms were between 50,000 and 60,000 cfs (NWS, 2003). Peak flow at the Skagit River near Concrete gage was approximately 165,500 cfs on October 21 (NWS, 2003). Both storms resulted in the flood stage of 28.0 feet being exceeded at the Skagit River near Concrete gage. The first storm had a peak stage very near the flood stage for major damage (32.3 feet); whereas, the second storm exceeded this level by nearly ten feet. However, the NWS (2003) reported that flow regulation upstream of Concrete resulted in reducing the second storm's peak stage level at the Skagit River near Concrete gage from 45.2 to 42.2 feet.

### Reservoir Water Levels

**Baker Lake—**Baker Lake, impounded by the Upper Baker dam, is approximately nine miles long and one mile wide. At the normal full pool elevation of 727.77 feet msl, the lake has a surface area of 4,980 acres, an estimated storage capacity of 274,221 acre-feet, and provides approximately 180,128 acre-feet of active storage above the minimum generating level. HDR (2004) reported that Baker Lake has average retention times of 25

to 70 days. Based on the 30-day, 10-year low flow and minimum generating pool elevation, retention time would be 461 days.

Baker Lake is held near full pool during the summer, and minimum reservoir levels typically occur between November and early April. Baker Lake's historical water surface levels from 1981 through 2002 varied 49.3 feet, between about 678.6 and 727.9 feet msl. Based on monthly median values, Baker Lake was within ten feet of full pool from June to October, and was lowest (about 30 feet below full pool) during March.

**Lake Shannon**—Lower Baker dam impounds Lake Shannon. At the normal full pool elevation of 442.35 feet msl, the reservoir is about seven miles long, and has a surface area of 2,278 acres and an estimated storage capacity of 146,279 acre-feet (plus unknown additional storage below the minimum generating pool level of 373.75 feet msl). The reservoir has an active storage capacity of approximately 116,770 acre-feet above minimum generating level. HDR (2004) reported that Lake Shannon has average retention times of 7 to 31 days. Based on the 30-day, 10-year low flow and minimum generating pool elevation, retention time would be 233 days.

Lake Shannon reaches the normal full pool elevation in most years. In some years, the normal full pool level is exceeded for short periods while water is spilled through the dam's spillway gates.

Based on monthly median water levels for the period 1981 through 2002, the reservoir was within ten feet of full pool from June to December. Monthly median levels were within five feet of the full pool elevation from July to September and November. The lowest monthly median level was approximately 33 feet below full pool and occurred in March.

**Depression Lake—**Depression Lake is adjacent to West Pass dike at the Upper Baker Development. Water enters Depression Lake, in part, as a result of subsurface leakage from Baker Lake, which is transmitted through native materials that include a series of lava flows underlying both Baker and Depression Lakes. When Baker Lake drops below an elevation of 701.77 feet msl, seepage into Depression Lake stops. It is estimated that 11 to 22 cfs exits the impoundment via fractures within the lava bed when it is near full pool (Shannon & Wilson, 1979). The water that collects in Depression Lake is transferred into Baker Lake via a water recovery pumping station and a channel leading to Baker Lake. Depression Lake receives an average inflow of 70 to 80 cfs, principally from groundwater sources, when Baker Lake is near full pool. Typically, Puget operates the pumping station for about 14 hours each day to maintain Depression Lake's water surface at an elevation of 695.77 to 698.77 feet msl, which results in a hydraulic residence time of about four days. At a water level of 698.77 feet msl, Depression Lake has a surface area of approximately 44 acres, and a storage capacity of about 234 acre-feet.

### Groundwater

Groundwater is present throughout the Baker River basin within consolidated and unconsolidated geologic units.

A generalized map of groundwater availability in the Skagit River basin (Drost and Lombard, 1978, as cited by Puget, 2002b) suggests that well yields from unconsolidated aquifer units in the Baker River basin range from 11 to 25 gallons per minute; generally sufficient for single-family domestic use and limited irrigation use.

Groundwater data for consolidated geologic units are limited; however, review of data for similar geologic units indicates that well yields would be adequate for only limited domestic use under most circumstances. Possible exceptions are the Sulphur Creek lava flows located along the southwest rim of Baker Lake and the Horseshoe Cove area of Baker Lake.

### Water Rights

Puget operates the Baker River Project under water rights issued by the State of Washington. Puget has approved water rights for the Upper Baker Development for 298,000 acre-feet of storage and a total of 4,800 cfs for the production of power. The Lower Baker Development is operated under water right certificates for a total of 190,000 acre-feet of storage and a total of 6,000 cfs for the production of energy. In addition to these rights, Puget has been issued water rights that are used for fish propagation at the Upper Baker spawning beaches, Sulphur Creek spawning beaches and rearing pond, and for domestic uses near the Upper Baker dam.

## 3.3.2.2 Environmental Effects

### Instream Flows

The Baker River Project can control most flows originating from the Baker River basin, except when inflow to the project exceeds its storage capacity or when it is under the direct control of the Corps for flood control operations. Under Current Operation, at least 80 cfs is continually provided to the Lower Baker River for operation of the adult fish trap-and-haul facility. This flow is provided by a combination of dam and abutment leakage (approximately 55 cfs) and at least 25 cfs through a bypass valve when the generating unit is offline (the valve has a capacity of 80 cfs). Typically, Puget operates the project in load-following mode to help meet energy demands. These operations cause daily flow fluctuations in the Lower Baker River of up to 4,200 cfs. Baker River Project load-following operations, along with Seattle City Light's similar operation of the Skagit River Project, have considerable influence on flows in the Middle Skagit River, and Baker River Project releases can either amplify or somewhat offset the effects of Seattle City Light's operations on the Middle Skagit River (figure 3-3).

Under Proposed Article 106, Puget would operate the project in accordance with an Interim Protection Plan for the first six years. Under the Interim Protection Plan, Puget would moderate flows in the Skagit River by limiting flow reductions attributable to the project and by capturing high flows or augmenting low flows in order to improve spawning conditions for Chinook salmon (see Appendix B for the Interim Protection Plan). Puget would also use best efforts to protect other species of salmonids by reducing the project's maximum generation from 4,100 to 3,200 cfs; by investigating ways and using best efforts to reduce ramping rates; and by limiting the amount of daily amplitude change and minimizing the difference between spawning and incubation flows.

Also under Proposed Article 106, Puget would prepare a Flow Implementation Plan that would: (1) specify the schedule for installing two new 750-cfs turbine-generator units in a new auxiliary powerhouse; (2) require implementation of Aquatics Tables 1 or 2 which specify new minimum flows, maximum flows and ramping rates and; (3) contain procedures for amending the above tables and plan.

Aquatic Tables 1 and 2 contain the specific operating procedures agreed to by the Settlement Parties. In summary, these procedures are: (1) a minimum flow of 1,000 cfs from August 1 to October 20 and a minimum flow of 1,200 cfs during the rest of the year; (2) a maximum flow of 3,200 to 5,600 cfs depending on the time of year, except when inflow to Baker Lake or flow in the Skagit River is high; and (3) downramp rates for the Skagit River at "Transect 1" (RM 56.5) of 0 to 2 inches per hour depending on the time of year and whether day or night. Downramp rates would be in effect when Skagit River flows immediately upstream of the Baker River confluence are less than or equal to 26,000 cfs. Aquatics Table 1 also shows the amount of flood storage the Corps would use at the Upper Baker Development pursuant to Proposed Article 107(a). Aquatics Table 2 shows the amount of flood storage available to the Corps at the Lower Baker Development pursuant to Proposed Article 107(b).

Proposed Article 106 also includes protocols for monitoring, evaluating compliance, and reporting. The Baker River near Concrete gage would be used for measuring compliance with flow release restrictions, and a combination of measurements recorded at this gage and at the Skagit River near Concrete gage would be used for measuring compliance with ramping rates. Puget would continuously monitor flow and stage at appropriate gages. Puget would also prepare annual flow implementation reports that address implementation of Proposed Article 106 in consultation with Ecology, FWS, NMFS, Forest Service, WDFW, the Swinomish Indian Tribal Community, Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and other ARG members. Puget would report any violations within 24 hours and would provide the Commission, Ecology and the ARG a follow-up report within two weeks of any incident.

Table 3-6: Aquatics Table 1. Flows and reservoir elevations proposed for the Baker River Project, FERC No. 2150.

| Lower Baker Development<br>Engineering Module: Three turbines (one 4,100 cfs turbine, two 750-cfs turbines | | | | | | | Upper Baker Development<br>No changes to turbine configuration | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Period** | **Min. Instream Flow (cfs)** | **Max. Instream Flow (cfs) (1)** | **Downramping Rates (2)** | **Flood Control Storage (AF)** | **Max Pool Level (ft) (NAVD 88)** | **Min Pool Level (ft) (NAVD 88)** | **Period** | **Flood Control Storage (AF)** | **Max Pool (3) Level (ft) (NAVD 88)** | **Min Pool Level (ft) (NAVD 88)** | **Max Daily Pool Level Change** |
| Aug 1-31 | 1,000 | 3,600 | 1-inch per hour day and night | No flood control requirement | 442.35 | 404.75 | Aug 1-31 | No flood control requirement prior to 10/1 | 727.77 | 724.8 | Max pool fluctuation ≤ 0.5 ft per rolling 24-hr period |
| Sep 1-3 | 1,000 | 3,600 | | | 442.35 | 404.75 | Sept 3 | | 727.77 | 724.8 | |
| 4-9 | 1,000 | 3,600 | | | 442.35 | 404.75 | Sept 9 | | 727.77 | 720.8 | |
| 10-30 | 1,000 | 3,200 | | | 442.35 | 404.75 | Sept 30 | | 727.77 | 718.8 | No constraints on max daily pool level changes |
| Oct 1-7 | 1,000 | 3,200 (1) | | | 442.35 | 389 | Oct 7 | Gradual drawdown to 74,000 AF by 11/15 | 727.11(4) | 713.8 | |
| 8-15 | 1,000 | 3,200 (1) | | | 442.35 | 389 | Oct 15 | | 726.23(4) | 685 | |
| 16-20 | 1,000 | 3,200 (1) | | | 442.35 | 389 | Oct 20 | | 725.68(4) | 685 | |
| 21-31 | 1,200 | 3,600 (1) | | | 442.35 | 389 | Oct 31 | | 724.47(4) | 685 | |
| Nov 1-15 | 1,200 | 3,600 (1) | 2-inches per hour day and night | | 442.35 | 389 | Nov 14 | | 712.42(4) | 685 | |
| 16-30 | 1,200 | 3,600 (1) | | | 442.35 | 389 | Nov 15-30 | 74,000 AF 11/15 to 03/01 | 711.56 | 685 | |
| Dec 1-31 | 1,200 | 3,600 (1) | | | 442.35 | 389 | Dec 1-31 | | 711.56 | 685 | |
| Jan 1-31 | 1,200 | 5,600 | | | 442.35 | 389 | Jan 1-31 | | 711.56 | 685 | |
| Feb 1-15 | 1,200 | 5,600 | | | 442.35 | 389 | Feb 1-15 | | 711.56 | 685 | |
| 16-28 | 1,200 | 5,600 | 0 inches per hour day and 2 inches per hour night | | 442.35 | 389 | 16-28 | | 711.56 | 685 | |
| Mar 1-31 | 1,200 | 5,600 | | | 442.35 | 389 | Mar 1-31 | Gradual refill | 718 | 685 | |
| Apr 1-30 | 1,200 | 3,600 | | | 442.35 | 389 | Apr 1-30 | No flood control requirement after 04/01 | 718 | 685 | |
| May 1-8 | 1,200 | 3,600 | | | 442.35 | 389 | May 1-8 | | 727.77 | 685 | |
| 9-14 | 1,200 | 3,600 | | | 442.35 | 389 | 9-14 | | 727.77 | 713.8 | |
| 15-22 | 1,200 | 3,600 | | | 442.35 | 389 | 15-22 | | 727.77 | 718.8 | |
| 23-31 | 1,200 | 3,600 | | | 442.35 | 389 | 23-31 | | 727.77 | 724.8 | Max pool fluctuation ≤ 0.5 ft per rolling 24-hr period |
| Jun 1-15 | 1,200 | 5,600 | | | 442.35 | 404.75 | Jun 1-15 | | 727.77 | 724.8 | |
| 16-30 | 1,200 | 5,600 | 1-inch /hour day and night | | 442.35 | 404.75 | 16-30 | | 727.77 | 724.8 | |
| Jul 1-31 | 1,200 | 5,600 | | | 442.35 | 404.75 | Jul 1-31 | | 727.77 | 724.8 | |

(1) Maximum release constraints eliminated when Baker Lake inflow > 10 % monthly exceedance flow OR Skagit River above the Baker River confluence > 24,000 cfs October through December.

(2) Downramping rates measured at the Baker River at Concrete, but based on stage changes observed at Transect 1 on the mainstem Skagit River below the Baker River confluence (RM 56.5).

(3) Maximum elevation unless otherwise directed by the District Engineer (Corps) during Flood Season.

No minimum flow requirements.
No maximum instream flow constraint.
No downramping limitations for environmental interests.

(4) Daily reservoir elevations between October 1, November 1, and November 15 shall be at or below straight lines drawn between 727.77 and 724.47 and between 724.47 and 711.56 for those respective dates with a gradual refill after March 1.

Table 3-7: Aquatics Table 2. Flows and reservoir elevations proposed for the Baker River Project, FERC No. 2150 if Proposed Article 107 is adopted.

**Lower Baker Development**

Engineering Module: Three turbines (one 4,100 cfs turbine, two 750-cfs turbines

| Period | Min. Instream Flow (cfs) | Max. Instream Flow (cfs) [1] | Downramping Rates [2] | Flood Control Storage (AF) | Max Pool [3] Level (ft) (NAVD 88) | Min Pool Level (ft) (NAVD 88) |
|---|---|---|---|---|---|---|
| Aug 1-31 | 1,000 | 3,600 | 1-inch per hour day and night | No flood control requirement prior to 10/1 | 442.35 | 404.75 |
| Sep 1-3 | 1,000 | 3,600 | | | 442.35 | 404.75 |
| 4-9 | 1,000 | 3,600 | | | 442.35 | 404.75 |
| 10-30 | 1,000 | 3,200 | | | 442.35 | 404.75 |
| Oct 1-7 | 1,000 | 3,200 [1] | | 29,000 AF 10/01 to 03/01 | 428.55 | 389 |
| 8-15 | 1,000 | 3,200 [1] | | | 428.55 | 389 |
| 16-20 | 1,000 | 3,200 [1] | | | 428.55 | 389 |
| 21-31 | 1,200 | 3,600 [1] | | | 428.55 | 389 |
| Nov 1-15 | 1,200 | 3,600 [1] | 2-inches per hour day and night | | 428.55 | 389 |
| 16-30 | 1,200 | 3,600 [1] | | | 428.55 | 389 |
| Dec 1-31 | 1,200 | 3,600 [1] | | | 428.55 | 389 |
| Jan 1-31 | 1,200 | 5,600 | | | 428.55 | 389 |
| Feb 1-15 | 1,200 | 5,600 | | | 428.55 | 389 |
| 16-28 | 1,200 | 5,600 | 0 inches per hour day and 2 inches per hour night | | 428.55 | 389 |
| Mar 1-31 | 1,200 | 5,600 | | No flood control requirement after 03/01 | 442.35 | 389 |
| Apr 1-30 | 1,200 | 3,600 | | | 442.35 | 389 |
| May 1-8 | 1,200 | 3,600 | | | 442.35 | 389 |
| 9-14 | 1,200 | 3,600 | | | 442.35 | 389 |
| 15-22 | 1,200 | 3,600 | | | 442.35 | 389 |
| 23-31 | 1,200 | 3,600 | | | 442.35 | 389 |
| Jun 1-15 | 1,200 | 5,600 | | | 442.35 | 404.75 |
| 16-30 | 1,200 | 5,600 | 1-inch /hour day and night | | 442.35 | 404.75 |
| Jul 1-31 | 1,200 | 5,600 | | | 442.35 | 404.75 |

**Upper Baker Development**

No changes to turbine configuration

| Period | Flood Control Storage (AF) | Max Pool [3] Level (ft) (NAVD 88) | Min Pool Level (ft) (NAVD 88) | Max Daily Pool Level Change |
|---|---|---|---|---|
| Aug 1-31 | No flood control requirement prior to 10/1 | 727.77 | 724.8 | Max pool fluctuation ≤ 0.5 ft per rolling 24-hr period |
| Sept 3 | | 727.03 [4] | 724.8 | |
| Sept 9 | | 724.82 [4] | 720.8 | |
| Sept 30 | | 717.09 [4] | 718.8 | No constraints on max daily pool level changes |
| Oct 7 | Gradual drawdown to 74000 AF by 10/15 [4] | 714.51 [4] | 713.8 | |
| Oct 15 | | 711.56 [4] | 685 | |
| 16-20 | | 711.56 | 685 | |
| 21-31 | | 711.56 | 685 | |
| Nov 1-15 | | 711.56 | 685 | |
| 16-30 | | 711.56 | 685 | |
| Dec 1-31 | 74,000 AF 10/15 to 03/01 | 711.56 | 685 | |
| Jan 1-31 | | 711.56 | 685 | |
| Feb 1-15 | | 711.56 | 685 | |
| 16-28 | | 711.56 | 685 | |
| Mar 1-31 | Gradual refill | 718 | 685 | |
| Apr 1-30 | No flood control requirement after 04/01 | 718 | 685 | |
| May 1-8 | | 727.77 | 685 | |
| 9-14 | | 727.77 | 713.8 | |
| 15-22 | | 727.77 | 718.8 | |
| 23-31 | | 727.77 | 724.8 | Max pool fluctuation ≤ 0.5 ft per rolling 24-hr period |
| Jun 1-15 | | 727.77 | 724.8 | |
| 16-30 | | 727.77 | 724.8 | |
| Jul 1-31 | | 727.77 | 724.8 | |

[1] Maximum release constraints eliminated when Baker Lake inflow > 10 % monthly exceedance flow OR Skagit River above the Baker River confluence > 24,000 cfs October through December.

[2] Downramping rates measured at the Baker River at Concrete, but based on stage changes observed at Transect 1 on the mainstem Skagit River below the Baker River confluence (RM 56.5).

[3] Maximum elevation unless otherwise directed by the District Engineer (Corps) during Flood Season.

No minimum flow requirements.
No maximum instream flow constraint.
No downramping limitations for environmental interests.

[4] Daily reservoir elevations between October 1 and October 15, shall be at or below straight lines drawn between 727.77 and 711.56 for those respective dates with a gradual refill after March 1.

*Effects Analysis*

The IPP operations (Appendix B), which would continue for the first 6 years after license issuance, were developed to improve spawning conditions for Chinook salmon downstream of the Baker River confluence. The IPP was developed to provide more protection to downstream aquatic habitats by reducing ramping rates and allowing Puget to release flows that fill the load-following troughs released from the upstream Skagit River Project. The early Chinook salmon spawning period of the IPP maintains relatively low flows during September 16 to October 15, which reduces the risk of egg losses associated with dewatering. The late Chinook salmon spawning period allows Chinook to spawn higher along the stream margins during the wetter half of the spawning period (October 16 to November 15), which provides some redd protection from potential flood flows during winter storm events. During October 1 to November 15, the IPP requires Puget to reserve up to 41,000 acre feet of reservoir storage, which can be used to protect downstream spawning habitat during dry conditions. Puget would have more control of project flow releases after the new auxiliary powerhouse at the Lower Baker Development is installed, which would provide further fishery habitat benefits in the Baker and Skagit Rivers.

After the first 6 years, Puget would operate the project in accordance with a Flow Implementation Plan that would incorporate Aquatic Tables 1 or 2 contained in Proposed Article 106. Based on an analysis of the effects of operating the project as proposed by Puget, low flows downstream of the Lower Baker Development would be substantially higher in the Lower Baker River following the installation of the new auxiliary powerhouse. Lower Baker River 90 percent exceedance flows would be increased from 80 cfs to at least 1,000 cfs during all months of the year, and flows for the Skagit River would increase nine out of 12 months (figure 3-5).

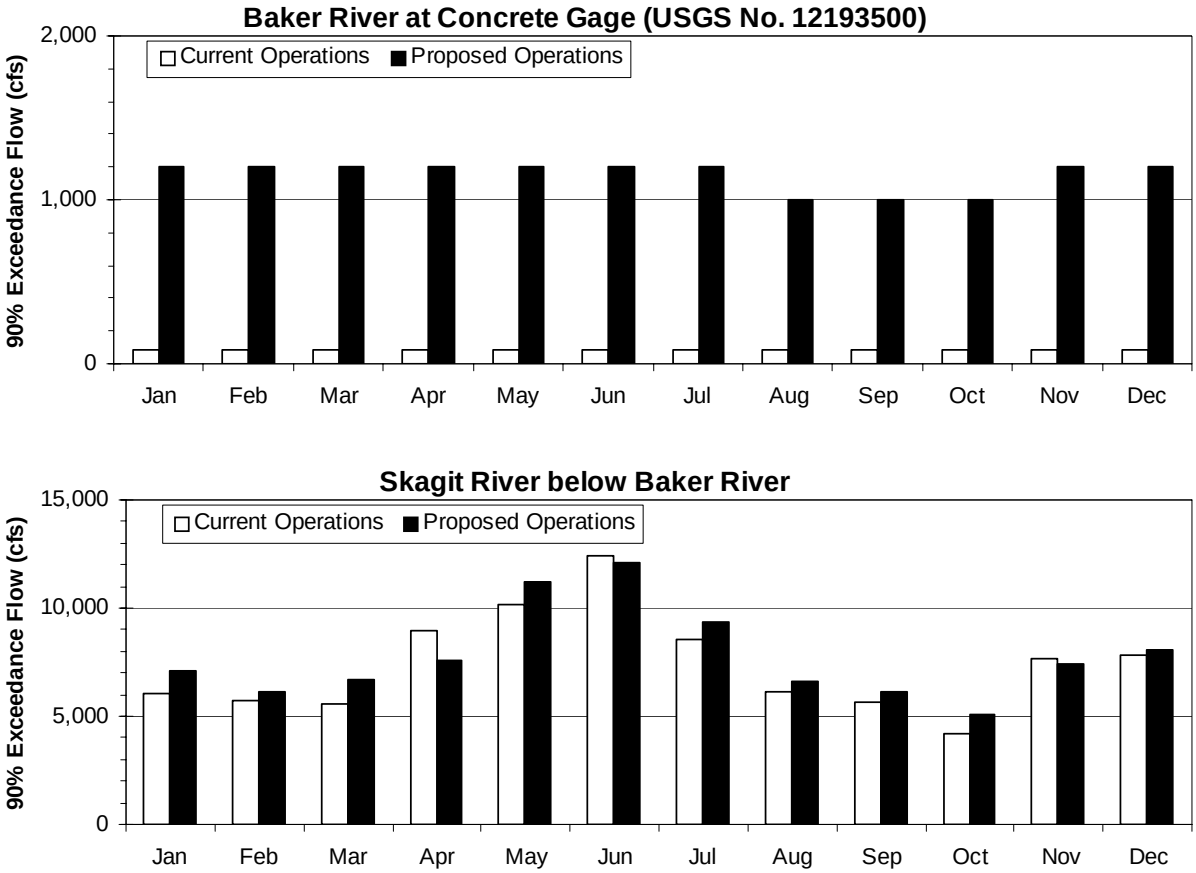



Figure 3-5. Modeled hourly 90 percent exceedance flows for Current Operations and Proposed Operations, based on HYDROPS results for five representative years.

Average hourly flows under the Proposed Action are similar to Current Operations January through March, May through August, and November through December (figure 3-6).

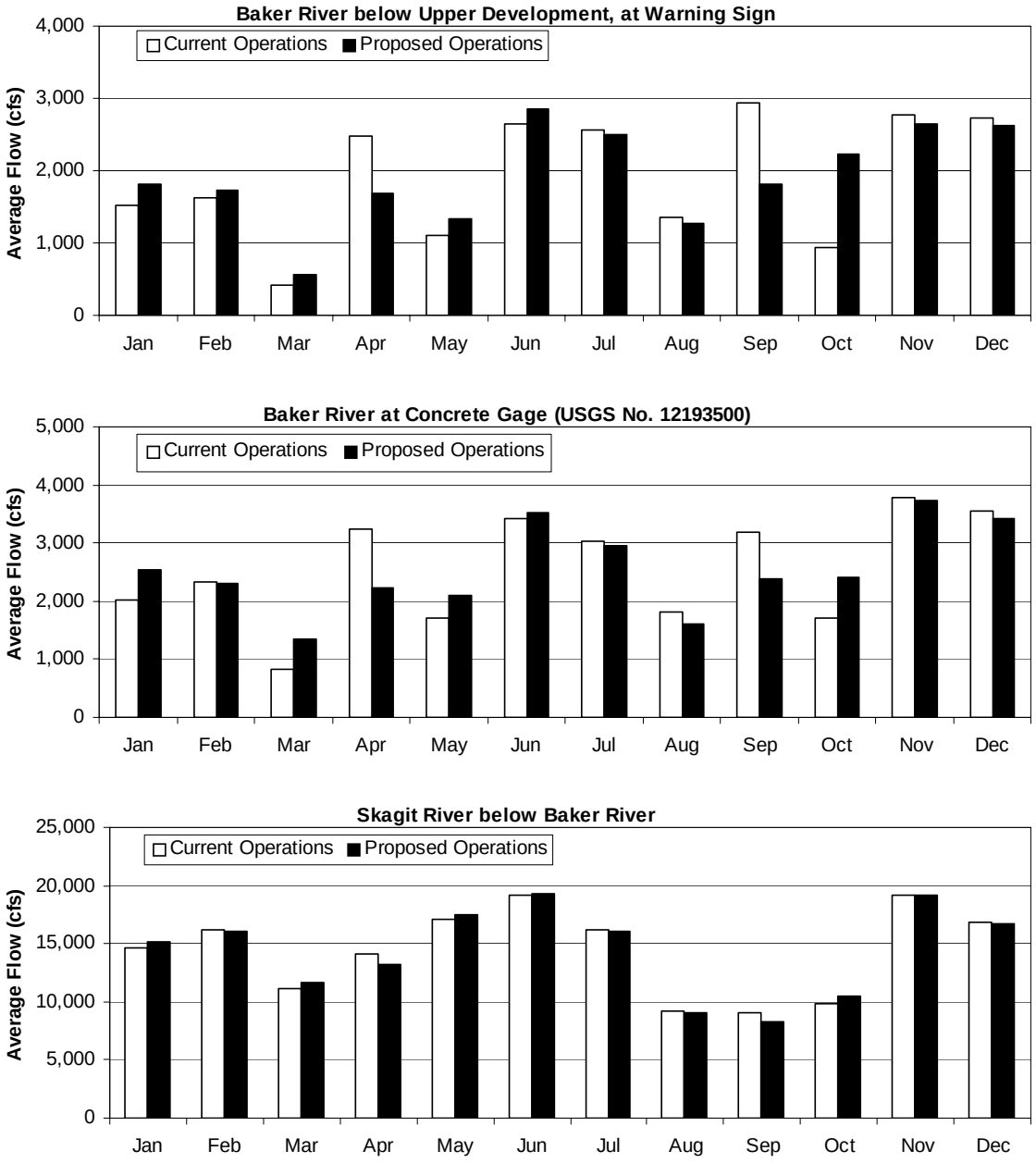



Figure 3-6. Modeled average hourly flows for Current Operations and Proposed Operations, based on HYDROPS results for five representative years.

The main differences in the monthly average flows would result from shifting the drawdown and refill season for Baker Lake. Under the Proposed Action, the largest changes would be reduced Baker River flows in April and September and increased Baker River flows in October. In the Skagit River, resulting changes would be small (five percent or less) compared to overall flows.

The ten percent exceedance flows, used to evaluate high flows, under the Proposed Action would be similar to flows under Current Operations in the Baker River downstream of the Upper Baker Development and in the Skagit River (figure 3-7). This information indicates that the greatest differences in ten percent exceedance flows would occur in the Baker River below the Lower Baker Development during March. Implementing the Proposed Action would reduce March flows from about 4,000 cfs to 1,200 cfs (70 percent) and would increase November to February flows from about 4,000 to 4,400 cfs up to about 5,400 to 5,600 cfs (26 to 33 percent). The ten percent exceedance flows for the Baker River below the Upper Baker Development would increase approximately 18 percent in October.

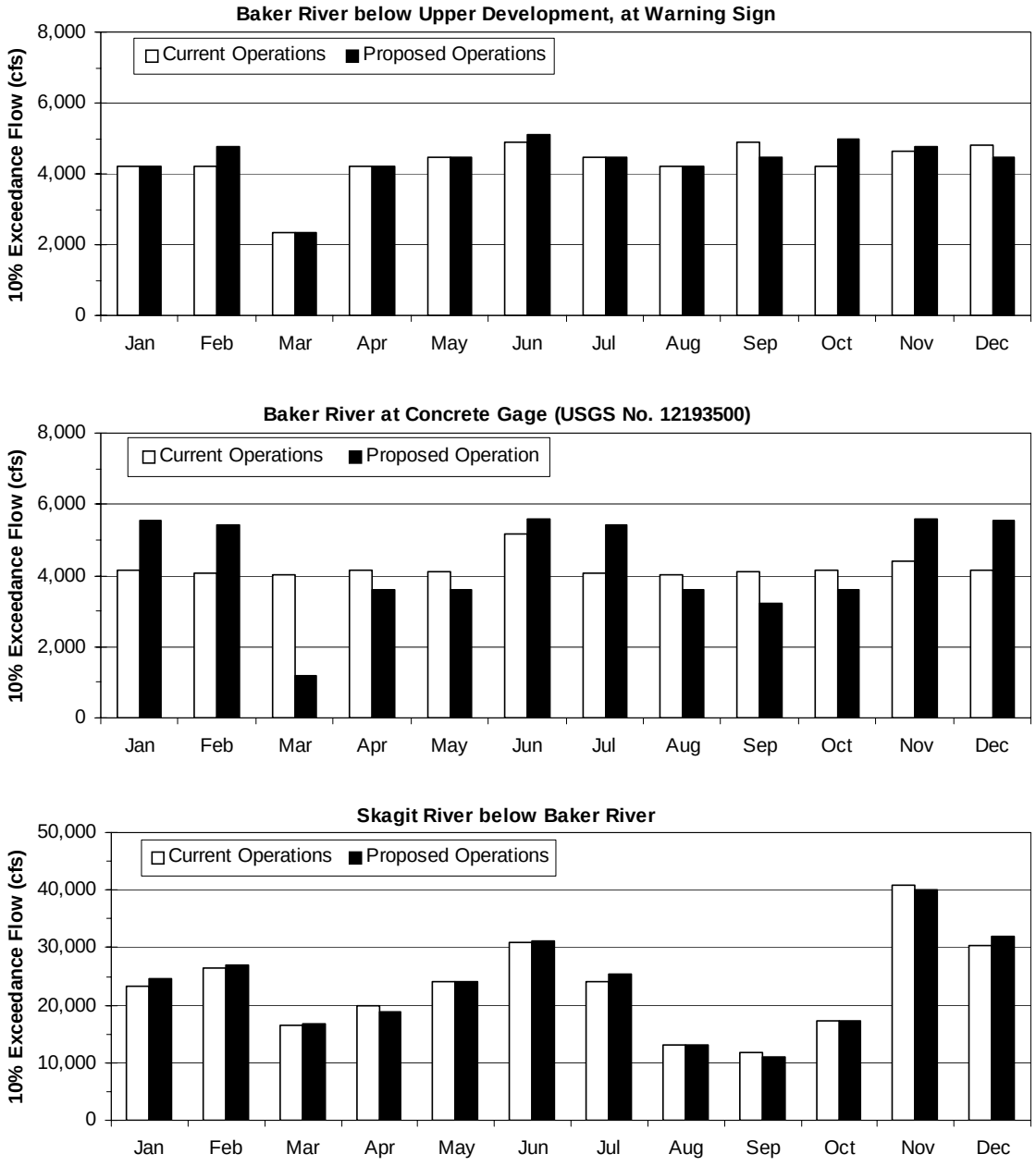



Figure 3-7. Modeled ten percent exceedance flows for Current Operations and Proposed Operations, based on HYDROPS results for five representative years.

Daily flow fluctuations in the Baker River downstream of the Upper Baker Development under the Proposed Action would remain similar to those that under the Current Operations (figure 3-8). In the Lower Baker River, flow fluctuations would be substantially reduced, by up to 4,000 cfs. In the Skagit River downstream of the project, flow fluctuations would be reduced by 500 cfs or more, 38 percent of the time. These reductions in flow fluctuations would be beneficial to salmonid spawning habitat conditions.

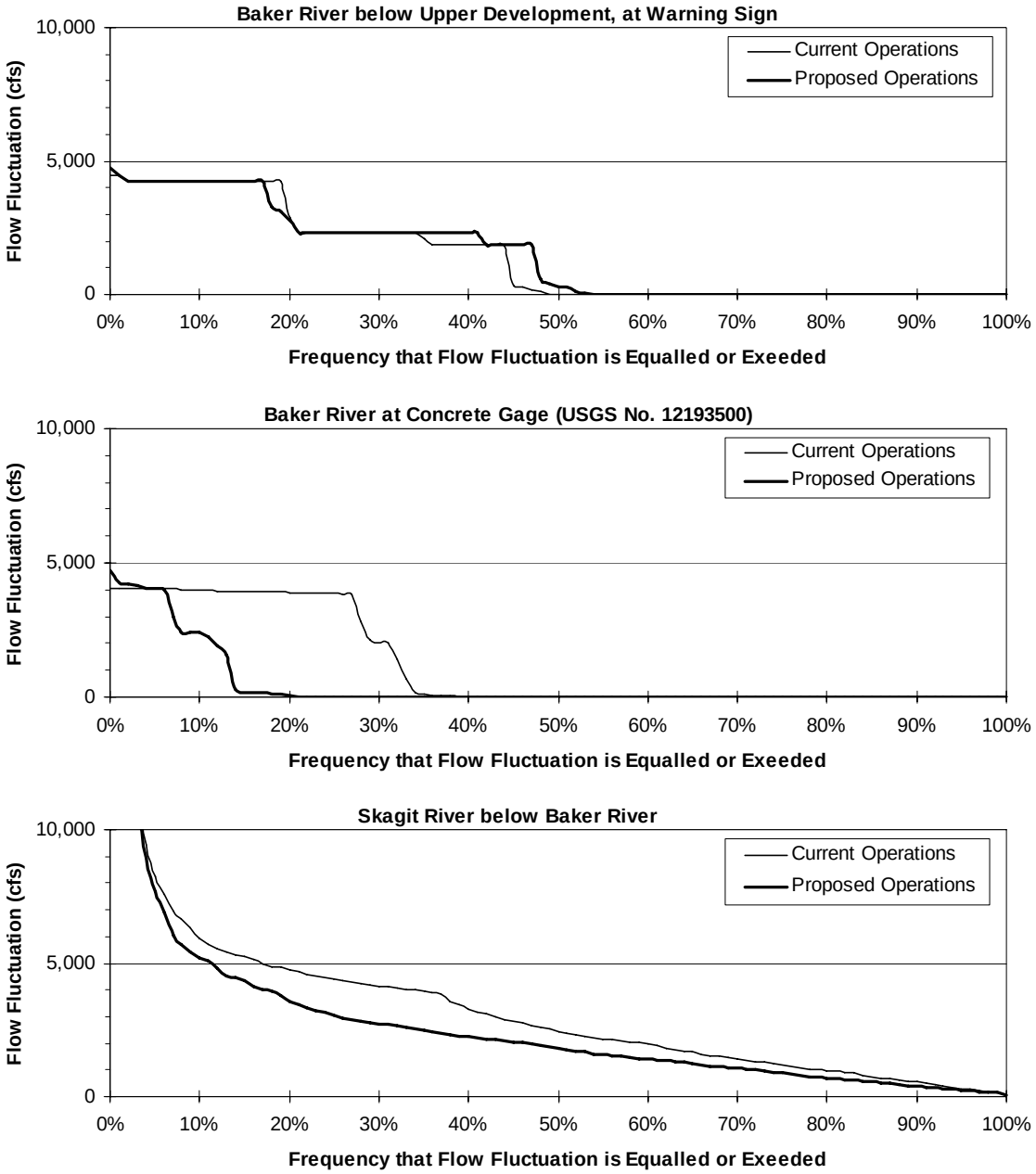



Figure 3-8. Annual percent exceedance of modeled daily flow fluctuations for Current Operations and Proposed Operations, based on HYDROPS results for five representative years.

**Agency Recommendations**

On March 16, and March 21, 2005, respectively, NMFS and WDFW filed two recommendations for fish protection measures not contained in the Settlement Agreement: (1) provide a flow continuation valve, and (2) schedule annual operation inspections; permit agencies and tribes other reasonable inspections; maintain and make available project operational records; and notify resource agencies of unusual operational incidents. Each of these recommendations is discussed below.

**Flow Continuation Valve—**NMFS and WDFW recommend Puget provide a flow continuation valve at the Lower Baker development to ensure compliance with new downramping rates, amplitude, and minimum flows contained in the Settlement Agreement. Both agencies indicate load rejections or other circumstances can cause turbine outages that prevent Puget from meeting downstream flow requirements. A flow continuation valve would ensure ramping rates and minimum flows can be maintained when turbine outages occur.

**Inspections, Records and Notification—**NMFS and WDFW recommend Puget schedule annual operation inspections for agencies and tribes to ensure that fish protection measures are functioning as expected. NMFS and WDFW also recommend Puget permit the agencies and tribes to inspect the project at any reasonable time before, during or after construction to evaluate activities that may affect fish and wildlife protection, mitigation, and enhancement measures. Both agencies recommend Puget maintain and make available a record of project operations including the daily amount of diversion, spill and fluctuation for all flows. In addition, NMFS recommends Puget document all unusual occurrences such as load rejections; powerhouse mechanical problems; turbine, intake and fish screen failures; and sedimentation events. NMFS says such events should be brought to the agencies' attention immediately.

*Effects Analysis*

**Flow Continuation Valve**—Interruptions in flow to stream reaches can dewater redds with incubating eggs and alevins. Salmonid eggs can withstand one to five weeks of continuous redd dewatering with no ill effects on hatching success or alevin and juvenile growth rates provided that the eggs do not free or reach lethal incubation temperatures and the surrounding sediments remain moist (Reiser and White, 1983). Yolk-sac alevins and pre-emergent alevins in redds are less tolerant of prolonged dewatering. For example, Becker et al. (1982) observed the survivability of newly hatched Chinook yolk-sac alevins in artificial redds decline from 96 percent survival after six hours of continuous dewatering, to 65 percent after 12 hours, 29 percent survival after 24 hours, and four percent after 48 hours. Older, pre-emergent alevin survivability decreased to one percent after only six hours of continuous dewatering.

Puget's PDEA contains several references to installing a flow continuation device including table 5-56 which describes as part of the Proposed Action "Installation of new turbines with flow continuation devices [to] minimize flow reductions due to load rejections." However, flow continuation devices or valves were not included as part of the Settlement Agreement. Commission staff contacted Puget to clarify the Proposed Action with respect to any flow continuation devices. Puget does not propose to install a flow continuation device at the Lower Baker development.[19]

NMFS and WDFW recommend Puget provide a flow continuation valve at the Lower Baker development to ensure compliance with new downramping rates, amplitude, and minimum flows contained in the Settlement Agreement. This recommendation would require a valve or valves designed to provide flows from 5,600 cfs (the maximum generation with the new units installed) to 1,000 cfs (the lowest minimum flow). Any valve would also have to be capable of meeting ramping rates contained in Proposed Article 106 which specifies downramping rates as low as one inch per hour.

Partial flow continuation would be provided at the Lower Baker development through the use of the two new 750 cfs turbine-generator units in the proposed new auxiliary powerhouse. As designed, the two new units would add redundancy at Lower Baker enabling Puget to maintain minimum flows despite the loss of any one unit or the loss of the two new 750 cfs units.

Despite this added redundancy, it's quite likely that over the term of any new license, circumstances would periodically force more than one unit off-line thus preventing Puget from meeting its new minimum flow and ramping rates and potentially leading to dewatering of salmonid redds and decreased survivability of pre-emergent alevins. Table H-8 of Puget's license application lists unscheduled outages at the Lower Baker development from 1998 to 2002. During this time, there were 29 instances of mechanical failure or other circumstances that caused unscheduled outages at Lower Baker. A flow continuation valve or valves would enable Puget to continue providing minimum flows and meeting ramping rates under most, if not all scenarios. Such a valve(s) would maintain the fishery benefits for which the minimum flows and ramping rates are proposed. We make our final recommendation regarding any need for flow continuation valves in the Comprehensive Development section.

**Inspections, Records and Notification—**As discussed above, NMFS and WDFW recommend Puget schedule annual operation inspections and permit agencies and tribes to inspect the project's fish protection measures at any reasonable time before, during or

[19] Telephone conversation record between Steve Hocking (FERC) and Cary Feldmann (Puget) filed with the Commission on May 19, 2005.

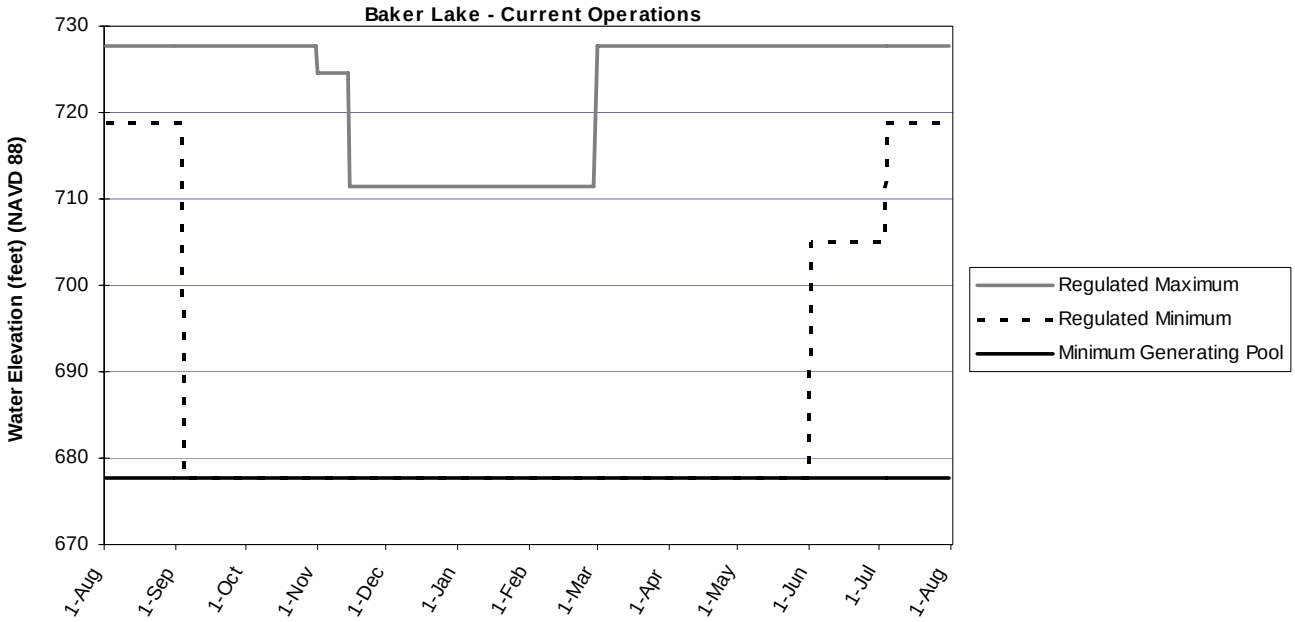
after construction activities. Both agencies recommend Puget maintain certain records and NMFS recommends documenting and notifying the agencies of unusual occurrences.

These recommendations would help ensure that the agencies and tribes remain informed about the construction, operation and maintenance of fish protection measures at the Project. Agencies and tribes could then provide Puget with timely feedback which should help Puget implement fish protection measures contained in the Settlement Agreement. We make our final recommendation regarding any need for the above inspection, records and notification measures in the Comprehensive Development section.

**Reservoir Level Management**

Puget does not have any lake level requirements or restrictions in its current license except for Article 32, which requires Puget to lower Baker Lake and provide up to 100,000 acre-feet of storage for flood control purposes if requested by the Corps (discussed in the next section). Under Current Operations, Puget operates the project as described under the IPP. Other than storage for flood control, Puget operates the project with the goal of meeting target water levels in both Baker Lake and Lake Shannon. Puget's goal is to maintain Baker Lake at elevation 718.77 feet msl at a minimum from the July 4$^{th}$ weekend through the Labor Day weekend. At Lake Shannon, Puget operates the project with the goal of maintaining water levels at elevation 404.75 feet msl at a minimum from April 15 through the Labor Day weekend.

Under the Proposed Action, lake levels would be required in accordance with Aquatic Tables 1 or 2 of Proposed Article 106. Figures 3-9 and 3-10 graphically display the proposed target maximum and minimum lake levels under the Proposed Action compared with Current Operations for both reservoirs.



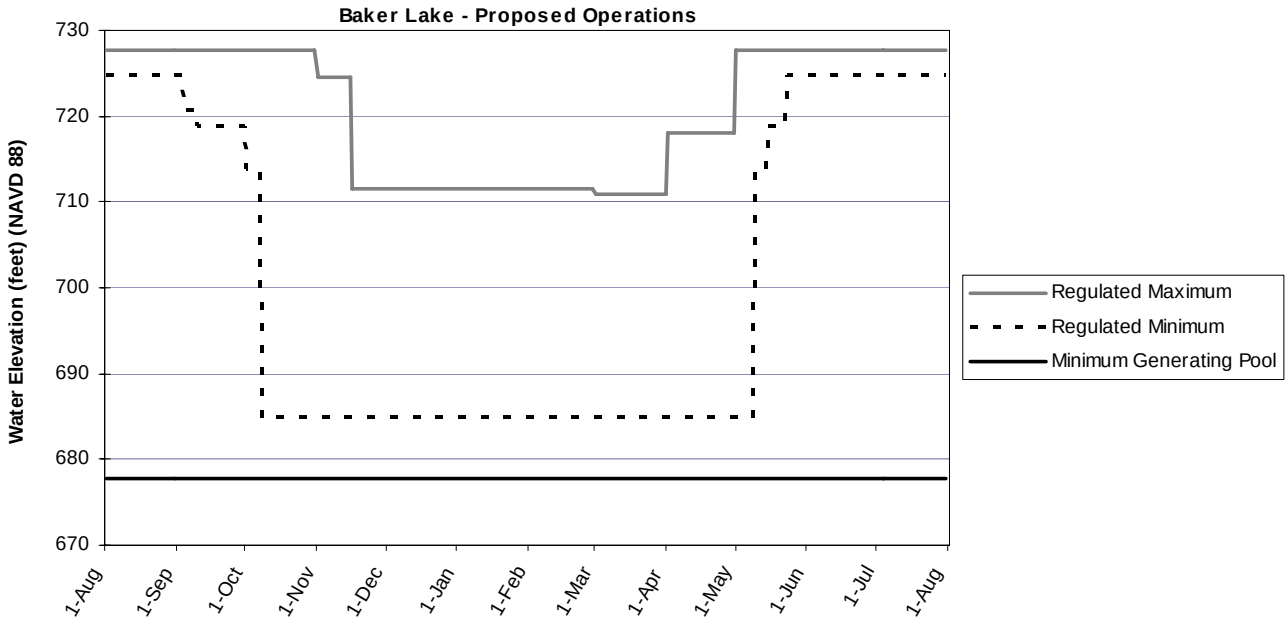
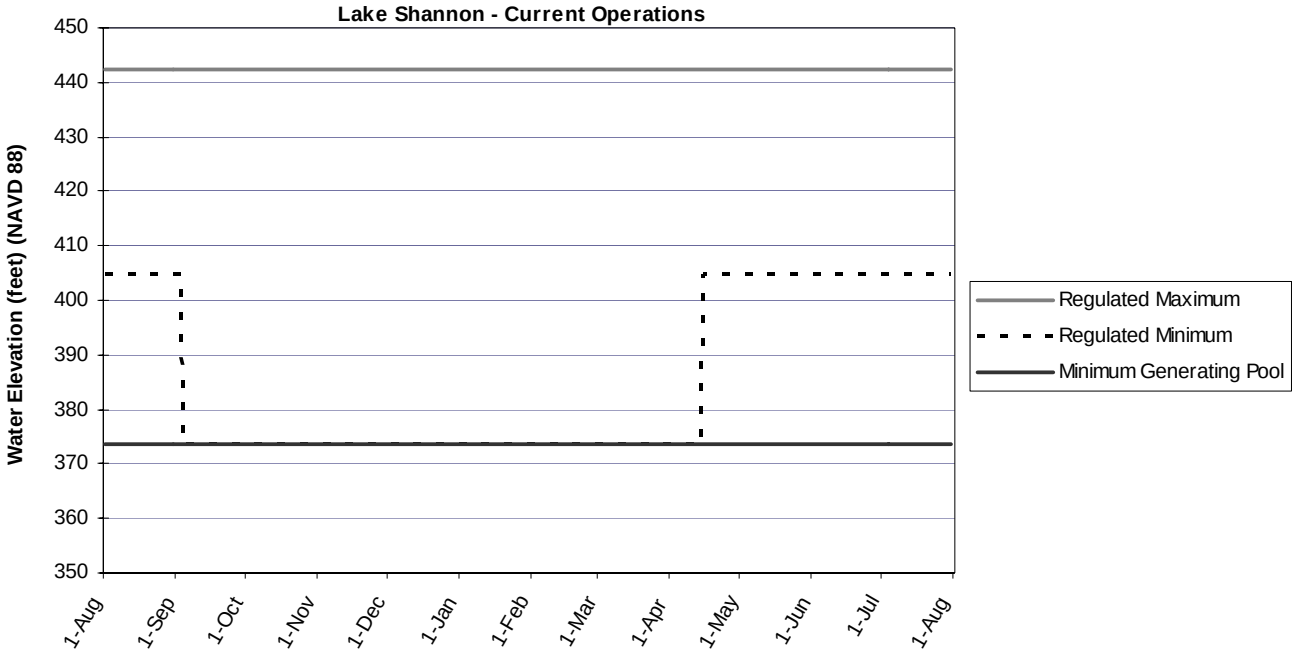




Figure 3-9. Target maximum and minimum Baker Lake water levels for Current Operations and Proposed Operations.



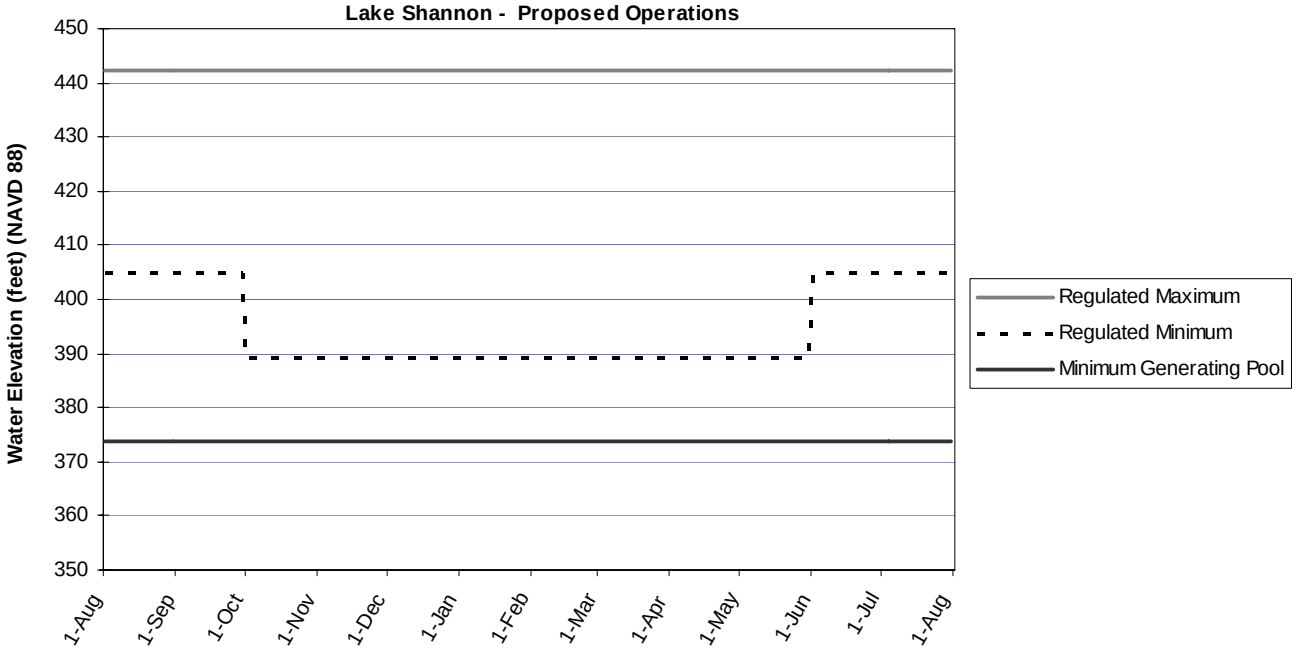
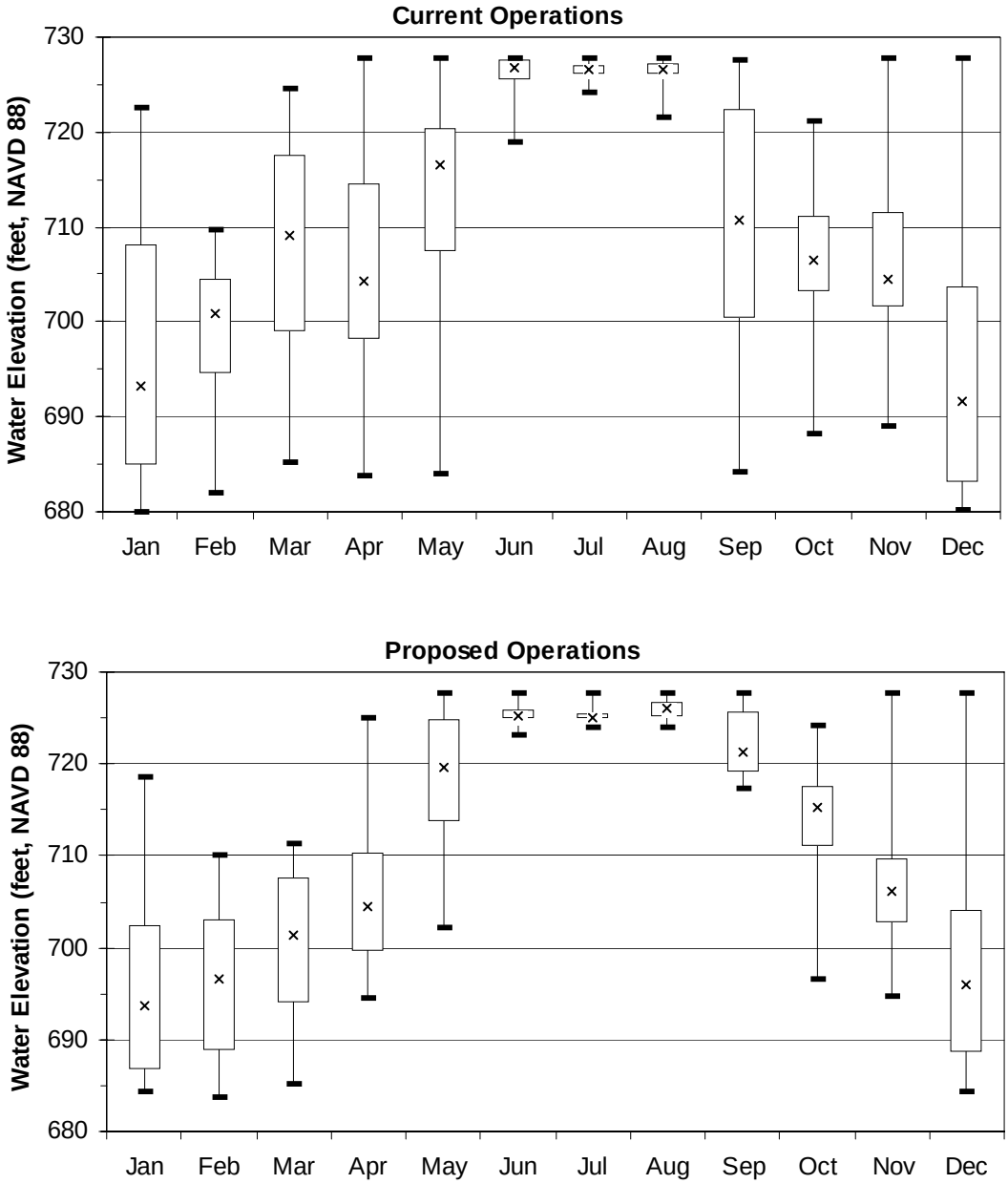




Figure 3-10. Target maximum and minimum Lake Shannon water levels for Current Operations and Proposed Operations.

*Effects Analysis*

Until the new auxiliary powerhouse is installed, Puget would continue to operate the project as described in the IPP. Puget would continue to make its best effort to limit downramping rates, limit daily amplitude changes, and minimize the difference between spawning and incubation flows.

Following the installation of the new auxiliary powerhouse, operating under Proposed Article 106, lake levels would vary compared to Current Operations. Figures 3-11 and 3-12 presents box plots of modeled hourly water levels for Baker Lake and Lake Shannon provided by Puget in the PDEA. Each plot is based on all HYDROPS hourly modeled elevations for a specific operational regime for the five selected years.

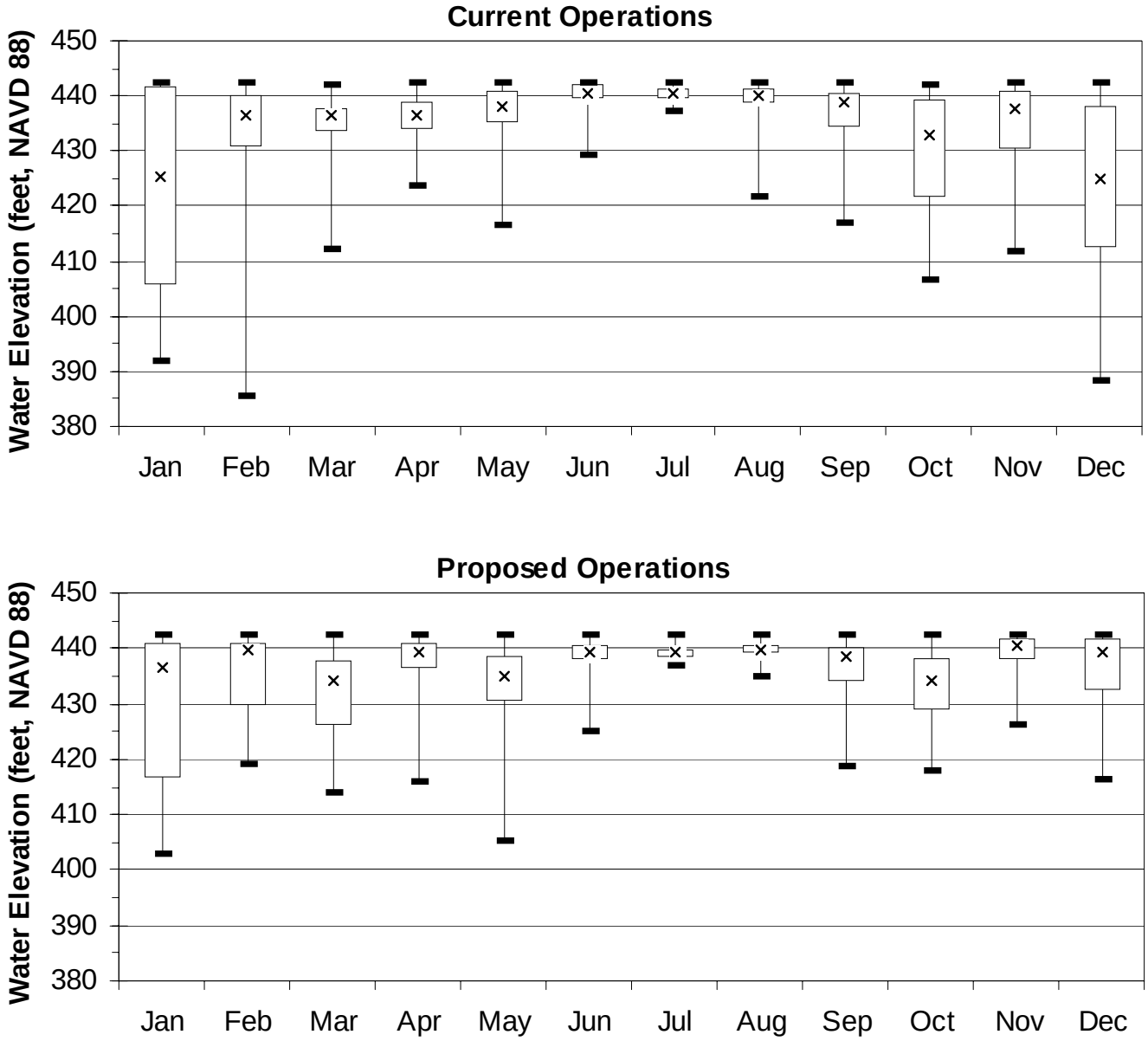



**Note:** Bars – Minimums and maximums.

Boxes – 25 and 75 percent exceedances.

X – Median values.

Figure 3-11. Modeled Baker Lake water elevations for Current Operations and Proposed Operations based on HYDROPS results for five representative years.




**Note:** Bars – Minimums and maximums.

Boxes – 25 and 75 percent exceedances.

X – Median values.

Figure 3-12. Modeled Lake Shannon water elevations for Current Operations and Proposed Operations based on HYDROPS results for five representative years.

Water elevation plots for Baker Lake show that operating the project as proposed would result in delayed fall drawdown and earlier spring refill compared to Current Operations. Instead of drawing down Baker Lake in late August/early September as occurs under Current Operations, drawdown would be delayed. The lowest modeled September water elevation for the Proposed Action is approximately 717.4 feet msl; whereas approximately 65 percent of the modeled values for Current Operations are below this level. The change in general operating parameters created by the flow regime prescribes a more controlled lake level drawdown with the Proposed Action relative to Current Operations. The change does not impair the ability of the project to reach scheduled flood storage elevations. The lowest modeled April and May elevations for the Proposed Action are higher than for Current Operations by more than 10.5 feet for April and more than 18 feet for May. This is a result of a much smaller drawdown in the somewhat dry year (energy year 1993) for the Proposed Action than Current Operations. Baker Lake water levels would generally be within three feet of full pool under both the Proposed Action and Current Operations during June through August.

For very wet years (e.g. energy year 1996), water levels would exceed the levels set to provide flood storage during most of November through January for both the Proposed Action and Current Operations. This reflects the same reservoir levels that occur under current active flood storage. The November 1 to March 1 flood storage levels would also be satisfied during each of the other four years modeled.

Under the Proposed Action, fall drawdown of Lake Shannon would continue to occur, although October through February water levels would typically remain higher than under Current Operations. April and May water levels would be much more variable under the Proposed Action than under current conditions. The Proposed Action would have little effect on the frequency that Lake Shannon's water level is within three feet of full pool during September.

Under the Proposed Action, Puget would continue to monitor the water levels of Baker Lake and Lake Shannon at 15-minute intervals or less for operational purposes. Monitoring the lake levels in this manner would provide the data necessary to document compliance with lake level restrictions.

**Flood Control Operations**

As discussed in section 2.1.2.2, Article 32 of the current license requires Puget to provide up to 100,000 acre-feet of storage at the Upper Baker Development for flood control purposes if requested by the Corps. Under Article 32, Puget must provide 16,000 acre-feet of storage from November 1 to March 1 and up to an additional 84,000 acre-feet from about September 1 to April 15 each year (table 3-8, column 1).

Table 3-8. Flood Control Storage at the Upper Baker Development in acre-feet. (Source: Staff).

| **Column 1** | | **Column 2** | | **Column 3** | | **Column 4** | |
|---|---|---|---|---|---|---|---|
| **Storage Available to Corps Under Existing Article 32** | | **Storage Used by Corps Under Existing Article 32** | | **Storage Available to Corps Under Proposed Article 107(a)** | | **Storage Corps Intends to Use Under Proposed Article 107(a)** | |
| 16,000 | 84,000 | 16,000 | 58,000 | 16,000 | 58,000 | 16,000 | 58,000 |
| 11/1-3/1 | about 9/1-4/15 | 11/1-3/1 | 11/15-3/1 | 10/15-3/1 | about 9/1-4/15 | 11/1-3/1 | 11/15-3/1 |
| Total 100,000 ac-ft | | Total 74,000 ac-ft | | Total 74,000 ac-ft | | Total 74,000 ac-ft | |

Currently, the Corps requires Puget to provide 74,000 acre-feet of storage in conformance with its 1977 Congressional authorization. Of this amount, 16,000 acre-feet are provided from November 1 to March 1 and an additional 58,000 acre-feet are provided from November 15 to March 1 each year (table 3-8, column 2).

Proposed Article 107(a) in the Settlement Agreement would enable the Corps to continue to use up to 74,000 acre-feet of storage at the Upper Baker Development but over an extended period of time. As shown in table 3-8, column 3, the Corps would be permitted to use storage at the project about two weeks earlier and continue using storage about six weeks longer, compared to the Corps's current operation.

Proposed Article 107(b) in the Settlement Agreement would provide the Corps an additional 29,000 acre-feet of storage at the Lower Baker Development for flood control from October 1 to March 1. This storage would be in addition to the storage provided under Proposed Article 107(a) at the Upper Baker Development.

*Effects Analysis*

Before the Corps can use an extended storage period contained in Proposed Article 107(a) or additional storage contained in Proposed Article 107(b), the Corps has stated that it must complete its own study and receive Congressional authorization. In pursuit of this goal, the Corps is currently performing a General Investigation (GI) study to evaluate how best to accomplish additional flood damage reduction in the Skagit River valley. In its study, the Corps is considering all flood control options in the basin including modified levees, diversions, and dikes, as well as additional storage and/or modified operations at the Baker River Project. The engineering, economic, and environment costs and benefits of each option will be evaluated leading to a recommendation for the most cost effective method(s) of reducing flood peaks. The Corps expects to complete its GI study by 2008. Until this time, the Corps intends to continue to implement its current flood control operation which as shown in table 3-8, column 4.

Both Puget and Skagit County retained consultants[20] to study the effects of additional storage at the project. Studies from each consultant were filed with the Commission.[21] These studies are preliminary and have not been completed, nor have these studies been technically reviewed by the Corps; however, preliminary results from both consultants indicate that an extended period of time and/or additional storage would yield additional flood control benefits. Tetra Tech's report states that all of the additional flood storage alternatives considered in its study would likely provide net benefits; however, the risk of flooding would still exist. Pacific International Engineering's study states that additional flood storage at the project would provide additional flood reduction benefits, but also notes that operation and structural modifications would need to be considered.

In summary, preliminary results indicate that the extended storage period contained in Proposed Article 107(a) and/or the additional storage in Proposed Article 107(b) could provide additional flood control benefits. Nevertheless, the Corps has stated that it cannot make any changes to its existing flood control operation until it completes its GI study and receives Congressional authorization. Given the Corps's position, and the pending GI study in which the Corps is evaluating all flood damage reduction options in the basin, including additional storage and/or modified operations at the Baker River Project, we defer to the Corps to complete its GI study and to file study results and any flood control recommendations for the project with the Commission. Appropriate reopener provisions in the license would ensure the Commission could require additional flood control measures in the future after the Corps has completed its GI study and has provided study results and any recommendations to the Commission.

As currently written, Proposed Article 107(a) would require Puget to provide "up to a maximum of 58,000 acre-feet" of additional storage as may be requested by the Corps "about September 1 to April 15." The use of the word "about" does not conform to standard license article language; a license article must be written in a fashion that enables the Commission to determine compliance with the article. To this end, Commission staff recommends removing the word "about" and any terms in proposed

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[20] Puget retained Tetra Tech, Inc. and Skagit County retained Pacific International Engineering.

[21] Tetra Tech, Inc., Draft Memorandum, Skagit River Flood Reduction Feasibility Study – Baker Project Evaluation – Phase I, dated November 14, 2003; Tetra Tech, Inc., Draft Memorandum, Skagit River Flood Reduction Feasibility Study – Baker Project Evaluation – Phase III, dated December 19, 2003; and Pacific International Engineering, Technical Memorandum, Analysis of Flood Control Storage at Baker River Project, dated August 27, 2004. These memoranda were attached to Puget's August 30, 2004, response to the Commission's July 30, 2004, request for additional information.

license articles that make compliance with the article difficult to determine. Also, because the word "maximum" does not add useful meaning to the aforementioned storage volume of 58,000 acre-feet, we recommend removing this word as well.

As currently written, Aquatics Table 2 does not match Aquatics Table 1 with regards to dates and lake elevations for flood control storage at the Upper Baker Development. These dates and lake elevations should be the same since only the Lower Baker Development has altered flood control storage procedures between the two tables. Commission staff recommends that Aquatics Table 2 be revised to match Aquatics Table 1 for the Upper Baker Development.

***Secondary Effects***

**New Auxiliary Powerhouse**

Constructing a new auxiliary powerhouse containing two new 750-cfs turbine-generator units would require Puget to take the existing Lower Baker powerhouse off-line for two months to dewater the flow line and remove the concrete plug in the tunnel leading to the new powerhouse. Puget has tentatively scheduled this action for September through mid-November. During this period, Puget would control flow releases to the Lower Baker River through Upper Baker powerhouse releases and Lower Baker spillway gate adjustments. Releases from the Upper Baker powerhouse would be variable and would depend on inflow to Baker Lake. Puget plans to maintain Lake Shannon at an elevation above 424.8 feet msl to control releases through the Lower Baker spillway gates.

#### 3.3.2.3 Unavoidable Adverse Effects

In spite of the protective measures contained in the Proposed Action, the project would still have the potential for short-term rapid changes in river flow and daily flow fluctuations as a consequence of hydroelectric project operations.

#### 3.3.2.4 Cumulative Effects

The Baker River Project affects flows in the mainstem Skagit River through its storage and release of water for power generation and flood control. Seasonally, the project tends to augment mainstem Skagit River flows from August through March and reduce mainstem Skagit River flows in April and May. Under Current Operations, Puget typically operates the project in load-following mode, which may cause fluctuations in mainstem Skagit River flows of up to 4,200 cfs over several hours each day (figure 3-3). At the Skagit River near Concrete gage (RM 54.1) located 2.4 miles downstream of the Baker/Skagit confluence, stage changes resulting from Baker River Project load-following operations may be between 0.9 foot and 1.2 feet.

Seattle City Light's operation of the Skagit River Project also affects flows in the mainstem Skagit River. The Skagit River Project consists of three dams and associated reservoirs on the Upper Skagit River, with the most downstream powerhouse Gorge located about 40 river miles upstream of the Baker/Skagit confluence. The Skagit River Project is typically operated in load-following mode with the amplitude of the Skagit River downramping events governed by terms of a 1991 Fisheries Settlement Agreement (FERC, 1991). The effects of fluctuating flow releases at the Skagit River Project are dampened as water flows downstream and take about six to eight hours to reach the Skagit River near Concrete gage (figure 3-4).

Snowmelt in the headwaters of the Skagit River basin also results in substantial daily fluctuations of Skagit River flows during portions of the year.

The effects of load-following operations at the Baker and Skagit projects and natural snowmelt can either amplify or offset each other depending on the timing of the releases. These interactive effects are largely attenuated by the time they reach the vicinity of Mt. Vernon (RM 15.7).

Major changes in Seattle City Light's operation of the Skagit River Project are not expected. We anticipate Seattle City Light would continue to operate the Skagit River Project in load-following mode and in accordance with the 1991 Fisheries Settlement Agreement (FERC, 1991).

Under the Proposed Action, Puget plans to install two new 750-cfs turbine-generators in a new auxiliary powerhouse that would enable operating the project in accordance with new minimum flows, maximum flows and ramping rates contained in Proposed Article 106. Changes in high flow releases would generally be small in comparison to Skagit River flows. Proposed Operations would result in moderate increases in Skagit River minimum flows. Synchronous operation of these new turbines with Lower Baker Unit No. 3 would typically result in slower downramping rates associated with Baker River Project load-following operations.

### 3.3.3 Water Quality

#### 3.3.3.1 Affected Environment

**Water Quality Standards**

The Washington Water Quality Standards designates the Baker and Skagit Rivers as Class AA (extraordinary) waters. Baker Lake and Lake Shannon are Lake Class waters. Class AA and Lake Class waters must meet or exceed water quality standards to protect all uses. Characteristic uses for Class AA and Lake Class waters include water supply (domestic, industrial, and agricultural); stock watering; fish and shellfish; salmonid and other fish migration, rearing, spawning, and harvesting; wildlife habitat;

recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment); hydropower development; and commerce and navigation. Numeric water quality criteria for Class AA and Lake Class waters are displayed in table 3-9.

Ecology's proposed revision of the Water Quality Standards, which are subject to approval by the EPA, designates uses of specific water bodies as presented in table 3-10. Numeric water quality criteria for the designated beneficial uses are given in table 3-11. The temperature criteria in table 3-11 is more restrictive for char than for salmon and trout spawning, core rearing, and migration.

Table 3-9. Washington water quality criteria applicable for surface waters. (Source: Chapter 173-201A WAC)

| **Constituent** | **Class AA** | **Lake Class** |
|---|---|---|
| Temperature | ≤16°C due to human activities; no increases of >0.3°C when natural conditions are >16°C [a] | No measurable change from natural conditions |
| Total dissolved gas (TDG) | ≤110% of saturation at any point [b] | |
| Dissolved oxygen (DO) | >9.5 milligrams per liter (mg/l) | No measurable decrease from natural conditions |
| pH | Within 6.5–8.5, human-caused variation of <0.2 units. | No measurable change from natural conditions |
| Turbidity | ≤5 nephelometric turbidity units (NTU) increase over background turbidity of ≤50 NTU or ≤10% increase over background turbidity of >50 NTU | ≤5 NTU over background conditions |
| Fecal coliform | Levels shall not exceed a geometric mean of 50 colonies/100 milliliters (ml) or 100 colonies/100 ml for 10 percent of samples. | |
| Toxic, radioactive, or deleterious materials | Concentrations shall be below those that have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health. | |
| Aesthetic values | Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste. | |

[a] Incremental temperature increases resulting from nonpoint source activities shall not exceed 2.8ºC. Incremental temperature increases resulting from point sources shall not exceed 23/(background temperature +5).

[b] TDG criteria does not apply when the stream flow exceeds the 7-day, 10-year frequency flood.

Table 3-10. Designated uses of water bodies affected by the project as revised in June 2003. (Source: Chapter 173-201A WAC, June 24, 2003)

| | **Char** | **Salmon and Trout Spawning, Core Rearing, and Migration** | **Extraordinary Primary Contact** | **Domestic, Industrial, Agricultural, and Stock Water Supply** | **Wildlife Habitat** | **Harvesting** | **Commerce/ Navigation** | **Boating** | **Aesthetics** |
|---|---|---|---|---|---|---|---|---|---|
| Baker Lake and all tributaries | X | | X | X | X | X | X | X | X |
| Baker River between Baker Lake and the mouth | | X | X | X | X | X | X | X | X |
| Skagit River | X[a] | X | X | X | X | X | X | X | X |

[a] Substantial numbers of char smolts use the Skagit River downstream of the Baker River confluence (WDFW, 1998).

Table 3-11. Washington water quality criteria as revised in June 2003. (Source: Chapter 173-201A WAC, June 24, 2003)

| **Constituent** | **Criteria** |
|---|---|
| Temperature[a] | 7-DADMax[b] not to exceed 12°C for designated char waters. 7-DADMax not to exceed 16°C for designated core salmon/trout waters. |
| TDG[c] | Shall not exceed 110 percent of saturation at any point of sample collection. |
| DO[a] | Lowest 1-day minimum not less than 9.5 mg/l. |
| pH | Shall be within 6.5 to 8.5, with a human-caused variation within the above range of less than 0.2 units. |

| Constituent | Criteria |
|---|---|
| Turbidity | Shall not exceed 5 NTU increase over background turbidity of <50 NTU or 10% increase over background turbidity of >50 NTU. |
| Fecal coliform | Extraordinary primary contact recreation: must not exceed a geometric mean of 50 colonies/100 ml, with no more than 10 percent of all samples exceeding 100 colonies/100 ml. |
| Toxic, radioactive, or deleterious materials | Concentrations must be below those that have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health. |
| Aesthetic values | Must not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste. |

[a] Additional restrictions are included in the regulation.
[b] 7-DADMax is defined as the average of seven consecutive measures of daily maximum temperatures, based on the period from 3 days before and 3 days after the date.
[c] TDG criteria does not apply when the stream flow exceeds the 7-day, 10-year frequency flood. TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with a department approved gas abatement plan.

Water quality in the basin is generally considered good and meets the needs of designated beneficial uses. Ecology does not include any of the Baker River reaches affected by the project on the 303(d) list of water-quality limited water bodies (Ecology, 2000). In addition to developing the 303(d) list, Ecology summarizes its routine stream monitoring data by using a Water Quality Index method developed for that purpose (Hallock, 2002). Ecology's (2004) assessment of the overall water quality in the Lower Baker River is of "lowest concern," based on the most recent data (water year 1993). Review of Ecology's Water Quality Index components indicates that suspended solids and turbidity are of moderate concern, and all of the other Water Quality Index components (i.e., temperature, DO, pH, fecal coliform, and total phosphorous) are of lowest concern.

The following description of water quality is based on:

- results of Ecology's (2004) routine water quality monitoring program;
- several license applications for new projects on tributaries to the Baker River (Puget, 1983a, 1983b, 1983c, 1982a, 1982b);
- a study of the limnology of Baker Lake and Lake Shannon in August 1962–October 1964 (Westley, 1966); and

- Puget's water quality monitoring program, which was initiated in March 2002 and continued through early February 2004 (HDR, 2004).

**Temperature**

**Baker River and Tributary Streams**—Puget monitored water temperature using thermographs at several locations in the Baker River and some of its tributaries, and in the Skagit River. Monitoring results between the summer of 2000 through January 2004 indicated that water temperatures were generally below the upper limit of 16°C in Sulphur Creek[22], Spawning Beach 4 outflow, Lower Baker River, and Skagit River. However, water temperatures of greater than 16°C occurred occasionally in the Lower Baker River, and the Skagit River both upstream and downstream of the Baker River confluence. Temperatures greater than 16°C were most common in the Lower Baker River, where they occurred approximately five percent of the days in July through September and approximately two percent of the days in October through December.

Water temperatures reported for numerous studies conducted since 1975 were compiled by R2 (2003b). Based on the R2 (2003c) compilation, along with data reported by Ecology (2004) for the Lower Baker River, temperatures in the Baker River and tributary streams in the basin generally remain below the upper limit of 16ºC.

**Baker Lake and Lake Shannon**—As part of the relicensing studies, Puget monitored the water temperatures of Baker Lake and Lake Shannon. Vertical temperature profiles were developed for both lakes, water temperatures in the Upper Baker powerhouse tailrace and at the Lower Baker intake were collected.

During portions of every winter, Baker Lake occasionally ices over, although water temperatures of about 4 to 6 °C occur throughout the water column during most of November through April. Thermal stratification of the reservoir began in early April and temperatures reached their maximum in late August to mid-September (HDR, 2004; Westley 1966). During 2003, the maximum temperatures at the reservoir's surface and mid-level intake depth were about 20°C and 14°C, respectively (HDR, 2004). The project is operated by withdrawing water from Baker Lake through the mid-level intake, which results in stagnation of water behind the dam and leads to deep water having cool temperatures (approximately 4–8ºC) throughout most of the year. The withdrawal of warm mid-level water from Baker Lake inhibits the formation of a well-defined thermocline in the reservoir's forebay. In late October, water temperatures were approximately 10°C throughout the water column of Baker Lake.

[22] Because of the level of interaction between surface and subsurface water, the hydrologic and thermal characteristics of Sulphur Creek differ substantially from most tributaries to the Baker River.

Results of Lake Shannon water temperature monitoring indicate that water temperatures generally range from 4 to 7°C throughout the water column between late November and mid-March. As with Baker Lake, Lake Shannon began to thermally stratify in early April. Lake Shannon surface temperatures were warmest in late August to early September. During 2003, the maximum temperatures at the reservoir's surface and intake depth were about 20°C and 17°C, respectively (HDR, 2004). The entire water column cooled to less than 6°C by mid-November indicating that the fall turnover had occurred.

The thermal regime of Lake Shannon is considerably different than that of Baker Lake. By mid-July, a thermocline forms at a depth of about 20 to 30 feet. By mid-October this thermocline no longer exists. Westley (1966) reported a second thermocline that forms at a depth of about 150 feet by mid-July, and continues to exist in October. This lower thermocline is a result of inflow from the Upper Baker Development flowing through Lake Shannon at depths of less than 150 feet during March through late October (Westley, 1966). Cooler inflow to Lake Shannon results in turnover in mid-December to spring.

Water temperatures of greater than 16°C were most common (41 percent of the days) at depths of 33 feet in Baker Lake during the summer. None of the other locations monitored had temperatures that exceeded 16°C on more than 10 percent of the summer days.

**Biological Productivity (Nutrients, DO, pH)**

This section describes factors closely related to primary productivity, including principal ions, availability of nutrients, DO, pH, and Secchi depth as an indictor of the euphotic (i.e., depth of light) zone in the case of reservoirs.

**Baker River and Tributary Streams**—Water in Baker River basin streams is generally soft, with low to moderate alkalinity (which limits the buffering capacity against changes in pH levels), and is dominated by either calcium carbonate or calcium sulfate. The sulfate ion is associated with intermittent fumarole activity around Mt. Baker. Streams that tend to be more dominated by calcium sulfate include Rocky, Sulphur, Boulder, Park, and Swift creeks and to a lesser extent Sandy Creek. Increased volcanic activity on Mt. Baker in 1975 reduced Boulder Creek's pH to as low as 3.4 standard units, in comparison to 6.0 to 6.6 prior to the increase in volcanic activity (Bortleson et al., 1977). Measurements reported by numerous sources indicate that other streams draining Mt. Baker have pH values of 6.3 to 8.2 (R2, 2003b). Streams flowing into Baker Lake and Lake Shannon have relatively steep gradients, which maintains high reaeration ratios and nearly saturated oxygen levels. Generally, these streams have low nitrogen and phosphorous concentrations.

The quality of water in the Baker River downstream of the Lower Baker dam is generally similar to streams entering Baker Lake and Lake Shannon. For water years 1979 to 1993, Ecology (2004) reported DO concentrations of 8.7 to 14.0 mg/l, pH of 6.6 to 8.2 units, and indicate low phosphorous and nitrogen concentrations for the Lower Baker River at Concrete (Ecology station 04B070).

**Baker Lake and Lake Shannon**—The Alaska Department of Fish and Game (ADFG) applied chlorophyll-a concentrations from limnologic and morphologic data collected by Puget from 1983 to 1989, to a trophic state index developed by Carlson (1977). ADFG's application of the trophic state index resulted in a classification of Baker Lake as oligotrophic (letter from G.B. Kyle and J.A. Edmundson, Limnologists, Alaska Department of Fish and Game, Soldotna, AK, to A. Aspelund, Fisheries Biologist, Puget Sound Power & Light Company, Bellevue, WA, November 10, 1992). ADFG also found that phosphorous levels were probably not limiting primary production in the reservoir, since seasonal total phosphorus levels typically fell within the mesotrophic range of 10 to 20 micrograms per liter ($\mu$g/l), and orthophosphorous (i.e., the biologically available form of phosphorous) comprises a large portion (approximately 60 percent) of total phosphorous levels. Mazumder (2004) reported that summer averages of total phosphorous concentrations generally continued to remain in the 10 to 20 $\mu$g/l range from 1989 to 2000, although concentrations dropped to about 5 $\mu$g/l during several years in the mid-1990s. Summer averages of nitrate concentrations remained at approximately 15 to 65 $\mu$g/l in 1983 to 1997, and then rapidly increased to levels greater than 200 $\mu$g/l in 1999 to 2001. Summer average concentrations of total organic carbon typically ranged from approximately 1.25 to about 5 mg/l, and reached a maximum of 37.57 mg/l in 1991. Summer averages of Secchi depths decreased from approximately 16.4 feet in 1993 to 11.8 feet in 2000. During the summers of 2002 and 2003, average Secchi depth readings were 11.5 and 15.6 feet, respectively.

Mazumder (2004) reported that total zooplankton density has increased consistently from less than 2,000 organisms per cubic meter to greater than 5,000 organisms per cubic meter, and total zooplankton biomass has increased from 10 mg/m$^3$ to 30 to 40 mg/m$^3$ during 1984 to 2000. The summer average density and biomass of total zooplankton were substantially higher than the annual averages. During 1997 to 2000, high density and biomass of zooplankton were spread over a longer period of spring to late summer than in 1980s and early 1990s.

Examination of DO data collected by Puget between 1982 and 2000 suggests that recent DO minimums are somewhat higher than those reported by Westley in 1962-1966. Westley's lower values may reflect high carbon levels that were present initially in the Baker reservoirs after the inundation of forest soils.

As described above, Mt. Baker volcanic activity increased mineral concentrations and lowered pH in Boulder Creek in 1975. These changes to the quality of water

entering Baker Lake resulted in short-term effects in Baker Lake. In September 1975, a distinct layer of water from Boulder Creek extended at least 0.3 mile down-reservoir (Bortleson et al., 1977). The likelihood of a distinct layer of Boulder Creek water extending into Baker Lake is primarily controlled by Boulder Creek's flow and water quality characteristics, relative rates of inflow from other sources, and the extent of reservoir stratification. Strong stratification, low inflows from other sources, and extreme water quality characteristics in Boulder Creek would produce the greatest opportunity for Boulder Creek water to persist as a discrete layer in the reservoir.

**Turbidity**

Turbidity in the Baker River basin is a function of several factors including glacial melt, landslides, surface runoff, wind, drafting the reservoirs to levels that result in resuspension of sediments deposited in the reservoirs, and travel time through the system. Many of these factors occur naturally, although land-use activities have accelerated erosion rates, and operation of the Baker River Project can also elevate turbidity levels by resuspending sediments that have been deposited in the reservoirs. In contrast, the reservoirs usually result in deposition of suspended sediments, thus reducing turbidity in the Baker River and the Skagit River downstream of the confluence with the Baker River.

Turbidity has been measured historically at numerous locations in the Baker and Skagit River systems. In samples collected since 1978, turbidity levels for Baker River tributaries and the Baker River upstream of Baker Lake range from less than 1 NTU to greater than 1,000 NTU. Turbidities were relatively stable throughout the year in the Upper Baker River; however, turbidity varied considerably during the 2003 monitoring period in Boulder Creek, Swift Creek, and Park Creek. Turbidities in these three tributaries generally were less than 5 NTU between March and mid-May, increased following the onset of snowmelt in June, peaked in September and October due to high runoff events, and decreased substantially in December (HDR, 2004). These conditions are representative of glacially fed streams, which typically experience elevated turbidities during the summer, due to glacial melt (Uehlinger et al., 2002).

Turbidities in Baker Lake, Lake Shannon, and the Upper Baker tailrace were generally less than 10 NTU from August 2002 until mid-October 2003, but major storm events can substantially increase turbidities. Following storm events, turbidity levels gradually subside - although they remained elevated at levels of greater than 30 NTU throughout the end of Puget's monitoring program in February 2004. These same storm events reduced Secchi depths of 16 to 14 feet in Baker Lake and to less than 1 foot in Lake Shannon.

Turbidities reported for the Lower Baker River since 1978 were generally less than 10 NTU, although levels of nearly 140 NTU occurred. Overall, the timing of high turbidity levels did not follow any clear trend.

In a study conducted by HDR (2004), no direct relationship was found between either Lake Shannon or Lower Baker River turbidity levels and corresponding daily reservoir elevations. This study did not identify the causes of elevated turbidity in the Lower Baker River. During mid- to late September 2003 when Lake Shannon's water elevation ranged from 385.7 to 402.8 feet msl, turbidity reported for Lake Shannon was less than 5 NTU.

Turbidity ranged from 0.2 to 15 NTU in the Upper Skagit River during water years 1979 through 1993, while ranging from 0.8 to 200 NTU in the Sauk River. Much of the water in the Upper Skagit River has to pass through Ross, Gorge, and Diablo reservoirs and would be expected to have lower turbidity levels than would otherwise be present naturally in an unregulated watershed like the Sauk. Turbidity in the Skagit River downstream of the Baker River confluence ranged from less than 1 to 83 NTU in samples collected since 1978.

**Total Dissolved Gas**

As part of the relicensing studies, Puget monitored TDG concentrations continuously at hourly intervals in the Lower Baker River at the adult fish trap; continuously in the Upper Baker powerhouse tailrace during October 2004, in the east (powerhouse) side of the channel about 200 yards downstream of the lower powerhouse tailrace during two spill events; and every other week in the Baker Lake and Lake Shannon forebays, downstream of the powerhouse tailraces of the Upper and Lower developments, and in the Skagit River upstream and downstream of the Baker River confluence.

TDG concentrations recorded approximately 1,000 feet downstream of the Upper Baker dam below the powerhouse tailrace ranged from 100 to 104 percent between October 7 and October 27, which is below the applicable 110-percent criterion. During this period, the Upper Baker Development followed its typical load-following operations with discharges ranging from about zero to 4,400 cfs on most days. TDG appears to have been increased somewhat by entrainment of air during turbine shutdown.

TDG concentrations recorded hourly at the Lower Baker adult fish trap ranged from 94 to 120 percent between October 30, 2002, and January 21, 2004 (HDR, 2004). Of the 9,264 TDG measurements for periods when flows were less than the 7-day 10-year frequency flood (7Q10-flood), 512 (5.5 percent) exceeded the 110-percent criterion. Evaluation of the relationship between TDG concentrations and Lower Baker River flows shows that TDG levels of greater than 110 percent occur at both low and high flows. Many of the elevated TDG levels at the adult fish trap appear to be caused by air venting of the turbine draft tube, which is done to prevent cavitation of the turbine during low and no generation events at the Lower Baker Development (figure 3-13). TDG levels of

between the 110-percent TDG criterion and 115 percent were generally associated with down-ramp events and typically lasted three to four hours. Review of TDG levels that occurred during a shorter than normal downramp on July 30, 2003, suggest that shorter downramp periods may result in lower TDG levels than typical operations (HDR, 2004).

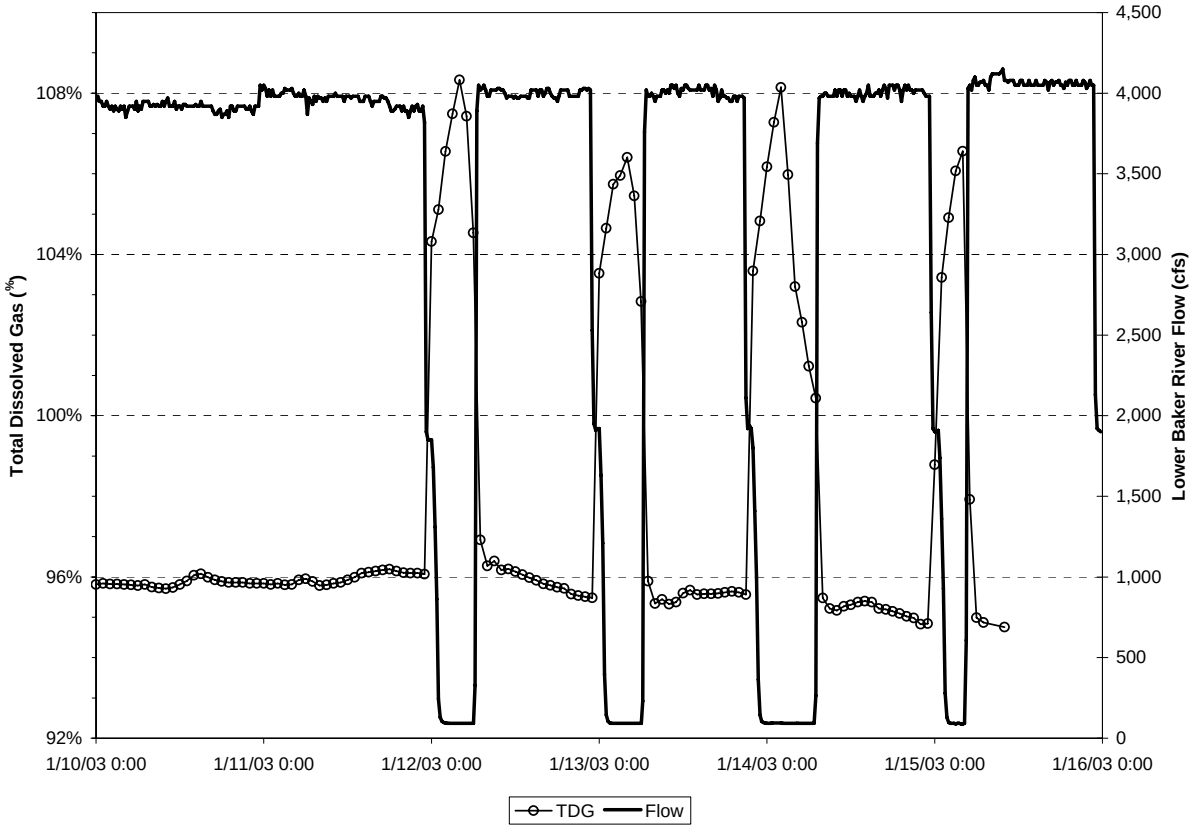


Figure 3-13. Typical patterns between TDG at the Baker adult fish trap and flow in the Lower Baker River, January 10 to 15, 2003. (Source: electronic mail from J. Oppenheimer, Environmental Scientist, HDR Engineering, Bellevue, WA, to B. Mattax, Louis Berger, Bellevue, WA, April 1, 2003)

Review of the continuous data for the adult fish trap also indicates that some spill events at the Upper and/or Lower Baker dam can elevate TDG levels above the 110-percent criterion. Flood control operations can result in water being routed through the spillway at Upper Baker dam. TDG was highest during a 2-hour period when Lower Baker River provisional flows were between 30,300 and 30,700 cfs. The 110-percent criterion does not apply for periods when flow is greater than the 7Q10, which was computed to be 13,300 cfs at the Baker River at Concrete USGS gage. In addition, TDG levels of up to 112 percent at the adult fish trap occurred on October 28 and 29, 2004, coinciding with the Lower Baker Development operating at its capacity. These data are believed to result from spill conditions at Upper Baker during the October 21 flood and subsequent weeklong passage through the Lower Baker reservoir.

An intense rainfall event in late January 2003 necessitated operating the project as mandated by the Corps. Operation of the project resulted in discharges from the Upper Baker Development exceeding the capacity of the Lower Baker Development's generator, and consequently resulted in the Lower Baker Development spilling approximately 2,000 to 2,600 cfs while generating at full load from January 28 through February 1, 2003. Analysis of TDG concentrations measured downstream of the Lower Baker powerhouse twice a day during this spill event indicates that TDG ranged from 99 to 103 percent (HDR, 2004). On the 6 days following the spill releases, TDG concentrations measured at this site were 96 to 100 percent of saturation. TDG levels recorded at the adult fish trap were generally within 2 percent of levels measured near the powerhouse (HDR, 2004). All of the TDG measurements made during this spill event satisfied the criterion of 110 percent.

TDG levels monitored in the Skagit River during 11 twice monthly monitoring events ranged from 95 to 107 percent (HDR, 2004).

### Coliform Bacteria

During water years 1977 to 1993, Ecology monitored fecal coliform levels in the Baker River at Concrete as part of its long-term monitoring program. Based on the values reported by Ecology (2004), fecal coliform levels satisfy the applicable standard in the Lower Baker River. The 204 reported fecal coliform measurements for water years 1977 to 1993 ranged from less than 1 to 70 organisms per 100 ml. The measurement of 70 organisms per 100 ml reported for May 21, 1991, was the only value of more than 20 organisms per 100 ml.

### Hazardous Materials

Puget uses hazardous materials in the normal operations of the Baker River Project. These materials include lubricants for the generators, fuel and oil for vehicles, and chemicals for propagating fish (i.e., formalin, sodium bisulfate, and sodium hypochlorite). Puget maintains and implements spill prevention control and countermeasure plans that are designed to address potential oil spills from the Upper Baker generation plant, Lower Baker generation plant, and the Baker Lake Resort. Each plan establishes procedures, methods, and equipment to be used to prevent a spill from occurring, if possible, or to contain and clean up a spill that does occur. Puget employees are aware of the onsite hazardous materials and are trained regarding the proper procedures and precautions to take in event of a spill.

Recreational activities can also result in the use of potentially hazardous materials over and around surface waters in the project area. Use of motorized watercraft presents the potential for spilling or leaking petroleum products and hazardous fuel additives such as methyl-tert-butyl ether (MTBE) into the reservoirs.

#### 3.3.3.2 Environmental Effects

The Settlement Agreement and the amended license application contain proposed license articles (Appendix A) that address water quality issues in all project-affected waters. FWS, NMFS, FS, WDFW, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community, recommend that Puget implement the proposed license articles of the Settlement Agreement. The following sections describe the measures proposed by Puget and the agencies, as well as our analysis of the proposed measures on water quality in the project area.

**Effects of Project Operations**

Operation of the project can increase turbidity along reservoir shorelines and occasionally in the Lower Baker River and Middle Skagit River, and project operations can elevate TDG levels in the project reach.

**Reservoir Water**

High turbidity levels have been documented in Lake Shannon and the Lower Baker River in the past (refer to the turbidity discussion presented in subsequent sections of this EIS). During a period when Lake Shannon's water level was drawn down to an elevation of approximately 378 feet msl, high turbidity was observed in the reservoir, and a turbidity of as high as 46 NTU was measured in the Lower Baker River. Other than these types of events, both reservoirs act as net deposition zones for suspended sediments that would otherwise be transported to the Skagit River.

Under the Proposed Action, the reservoir and flow management target is defined in Proposed Article 106. We discuss the overall management of the reservoirs and their effects on Baker Lake and Lake Shannon water levels in the discussion of Reservoir Level Management in section 3.3.2, Water Quantity.

The proposed water quality measure (Proposed Article 401) sets target minimum operating levels for Baker Lake at elevation 685 feet msl and Lake Shannon at elevation 389 feet msl to minimize resuspension of sediments deposited in the reservoirs. This measure also includes development and implementation of a Water Quality Monitoring Plan to ensure that the project would comply with applicable state water quality standards. Puget would develop this plan in consultation with the Ecology. Implementation of this measure would include monitoring water quality throughout the new license period, and Puget would report annually the results of monitoring to the Commission and Ecology. Proposed Article 401 states that Puget may submit requests to Ecology for reduced sampling frequencies and/or parameters, if appropriate.

*Effects Analysis*

During the first 6 years of a new license term under the Proposed Action (Interim Operations), the project would operate under the IPP as detailed in the instream flows Effects Analysis provided in section, 3.3.2.2. We anticipate that turbidity levels would not be altered substantially from those observed under operation implemented in 2003 and 2004 (see turbidity discussion provided in section, 3.3.3.1, Water Quality Affected Environment).

Analysis of reservoir water levels modeled to represent Proposed Operations following construction of the two new generating units suggests that project Operations could somewhat reduce the potential to resuspend fine-grained sediments in Baker Lake because of reduced surface water-level variability during the drawdown season. Resulting reductions of turbidity in Baker Lake would be small and localized. Greater reductions in turbidity would likely occur in Lake Shannon because of a reduction in the extent and frequency of drawdown, a reduction in daily fluctuations in the 1- to 5-foot-per-day range, and less frequent occurrence of elevations corresponding with high quantities of fine-grained materials (less than 420 feet msl). However, we anticipate that these reductions in turbidity would generally be localized, since HDR's (2004) evaluation of the effects of Lake Shannon drawdown did not reveal a significant relationship between drawdown to elevations as low as approximately 386 feet msl and turbidities near the Lower Baker dam.

Under Proposed Article 401, Puget would develop and implement a plan to monitor water quality. This plan would identify measured exceedance(s) of applicable state water quality standards. We would expect to see improvements in water quality operating under the Proposed Action.

**Project Releases**

TDG levels at the adult fish trap exceeded the maximum allowable limit of 110 percent during periods of extremely low flows and high flows in the Lower Baker River (see TDG discussion provided in section, 3.3.3.1, Water Quality Affected Environment).

*Effects Analysis*

During monitoring of operations in 2003 and 2004, TDG sometimes exceeded the applicable criterion of 110 percent (see TDG discussion provided in section, 3.3.3.1, Water Quality Affected Environment). These high TDG levels generally occurred when outflow from the project was less than 140 cfs, and were linked to air venting of the turbine. Increasing the minimum flow release from 80 cfs to at least 1,000 cfs and using the two new 750-cfs turbines as called for in the Proposed Action is expected to reduce TDG levels to less than 110 percent during the lowest flow releases.

Spill events also cause non-compliance with the TDG standard in the Lower Baker River. Based on our evaluation of the results of continuous monitoring of TDG at the adult fish trap during the January 2003 and October 2003 spill events (HDR, 2004), we estimate that spills of 3,500 cfs or more at the Lower Baker dam typically cause TDG to exceed 110 percent. The 110-percent criterion is not applicable at flows above the 7Q10, which is 13,300 cfs at the Baker River at Concrete gage. Puget developed a conservative estimate of the effect of spills under the Proposed Operations on exceedances of the TDG standard by analyzing the frequency of modeled Lower Baker spills of 3,500 cfs or greater coinciding with flows of 13,300 cfs or less.[23] This analysis suggests that Lower Baker spills would result in non-compliance with the applicable TDG standard very seldom (approximately 0.8 percent of the time) under Current Operations and virtually never (less than 0.1 percent of the time) under the Proposed Action.

Under the Proposed Action, Puget may occasionally still need to spill water at the Upper and/or Lower dams while not routing water through the generators. As under current conditions, this can result in non-compliance with the TDG standard. Development and implementation of a Water Quality Monitoring Plan as required under Proposed Article 401 would provide a mechanism to assess the extent of project effects on TDG and other stream water quality constituents. It would also provide a way to evaluate compliance with applicable state water quality standards, identify means to resolve exceedances of the state standards, and provide feedback on the success of methods used to avoid recurrence of problems. Proposed Article 401 also provides assurance that Puget would apply all known, available and reasonable methods of prevention, control, and treatment as necessary to resolve project effects causing non-compliance with applicable state water quality standards.

**Stormwater Management and Erosion Control**

Operation and maintenance of the project necessitates use and maintenance of various facilities including access roads, transmission corridors, structures, and staging areas. Some of these actions require storage, use, and disposal of potentially hazardous materials, and present a risk that these materials could enter waters of the state and consequently adversely affect beneficial uses of these waters. Some project maintenance activities can increase the risk of erosion and cause runoff, which adversely affect water quality. In addition, implementation of measures included in the Proposed Action has the potential to increase the risk of erosion along with the potential of contaminating waters with pollutants.

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[23] Operation of the two new 750-cfs capacity generating units would increase maximum generation flows at the Lower Baker Development from approximately 4,100 cfs to 5,600 cfs (approximately 37 percent) and would substantially dilute the effects of elevated TDG levels in water that has been routed through the spillway in comparison to current conditions.

Under the Proposed Action, Puget would develop, in consultation with Ecology, a water quality protection plan (Proposed Article 401). This plan would address the control of potential sources of pollutant releases from project construction, operations, or emergencies by including a stormwater pollution prevention plan and in-water work protection plan. The plan would address all project-related facilities including access roads; boat ramps; transmission corridors; portable toilets; hatcheries and fish collection, handling and transportation facilities; and staging areas for all activities related to project operation, maintenance, and repair. Following development of the plan and Ecology approval, Puget would file the plan with the Commission for approval.

Puget would develop and implement a stormwater pollution prevention plan that would specify best management practices to prevent the project from contaminating surface and ground waters. To accomplish this goal, Puget would specify spill prevention and containment procedures for chemicals, hazardous materials, and petroleum products including refueling procedures, measures to take in the event of a spill and reporting and training requirements. Puget also would develop an in-water work protection plan that specifies best management practices for project activities that require work within the project's surface waters. This work includes, but is not limited to, application of herbicides, pesticides, fungicides, disinfectants, and lake fertilization. An appropriate water quality monitoring plan would be developed and implemented for all in-water work.

*Effects Analysis*

Puget's proposal to develop a water quality protection plan (Proposed Article 401) would ensure that appropriate stormwater management measures are adhered to during the construction and operation of the project. Using Puget's proposed best management practices to limit erosion and protect beneficial uses of water resources will improve the quality of stormwater produced by Puget's activities.

### *Secondary Effects of Proposed Measures*

In this subsection we describe the direct, cross-resource effects of the proposed license articles. Proposed license articles designed to enhance one resource may have beneficial or adverse effects on other resources and are considered secondary effects.

#### Lower Baker Power Plant Modifications

To enable provision of the ramping and minimum flow restrictions set in Proposed Article 106, the Proposed Action would include partial rehabilitation of the original Lower Baker Development power generating facilities that were destroyed by a 1965 landslide. This would include the following: (1) Constructing a new permanent access platform adjacent to the west side of the powerhouse foundation; (2) Excavating and hauling the slide debris from the old powerhouse location to a nearby disposal area: (3)

Identifying the presence of any contaminants from old equipment: (4) Removing the original Units 1 and 2, if needed; (5) Selective demolition and excavation of existing structures; and (6) Linking the two new 750-cfs turbine generators to the existing abandoned penstocks.

Because of limited access to the area, Puget would use barge-mounted excavators, drilling equipment, and lifting cranes for preparation and installation of piers and abutments. Following installation of the piers and abutments, a barge-mounted heavy lift crane would be used to place the precast concrete decking onto the piers and abutments.

There is an estimated 10,000 cubic yards of debris, including loose soil, broken rock, and vegetative cover that would be removed from the area on top of and above the original Units 1 and 2. Because of the risk of damage from this material falling onto the new facilities installation, this material would be removed before any new structures are placed. Puget plans to do this by loading the excavated material onto 40-ton off-road haulers that would haul the material to a Puget-owned disposal area.

The extent of previous removal of the original Units 1 and 2 is unknown; therefore, Puget has assumed that they would need to be removed. Puget would do so by using a small to medium sized rubber tired crane to lift the units onto short lowboys or haul trucks, which would transport them to a final disposal site or salvage area. Puget could concurrently identify the presence of any contaminants that may have originated from the old equipment, so that they can be disposed of in a safe manner.

Puget would conduct mechanical demolition and limited controlled blasting to remove portions of the original concrete structures.

*Effects Analysis*

Modifying the Lower Baker power plant as proposed in the Proposed Action would require earthwork and could disturb potentially hazardous materials from the old equipment at the site. These activities could result in increased erosion and further contamination of the area if appropriate actions are not taken. Puget would limit the risk of increasing erosion and degrading water quality during and following construction activities by implementing a water quality protection plan (Proposed Article 401). This would include adoption of best management practices that limit the timing of activities such as in-water construction, control of sources of pollution, and limiting erosion at the site.

It would be important to determine the extent of contamination by potentially hazardous materials prior to their disturbance through the preparation of a Phase I EA. If potentially hazardous materials were present, it would be important to conduct the removal of the original equipment during a season of low precipitation to limit the

potential for runoff from the work site to spread the contamination. By consulting with the Ecology, Puget could determine a preferred method for investigating the extent of contamination and discarding contaminated materials.

Implementation of appropriate best management practices would limit the risk of construction-related erosion, and is expected to result in minor localized erosion during and immediately after the 2-year construction period. Minor erosion of the construction site along with some runoff of fine-grained sediments is expected to cause short-term localized turbidity increases of more than the amount allowed by the state criterion. The general pattern expected is that turbidity would be elevated in the immediate vicinity of point discharges to the Lower Baker River, but turbidity would dissipate quickly as inflowing water mixes with the Baker River flow.

To construct the new access platform, it would be necessary to conduct in-water construction while installing the platform piers and abutments. By performing the in-water construction during a low-flow period, Puget could ensure that the piers and abutments could be constructed in an efficient manner and adverse effects on the aquatic ecosystem could be limited. It would also be important to implement appropriate best management practices for this activity that would limit the likelihood of introducing potentially hazardous materials or substantially increasing turbidity to the Lower Baker River.

Since the status of the original Units 1 and 2 and related facilities is unknown, it would be important to determine the extent of contamination by potentially hazardous materials from them prior to disturbing them. Puget could determine a preferred method to accomplish this goal and discard any materials containing potentially hazardous materials. By conducting these actions, Puget could minimize the risk of introducing any contaminants that exist into surface and ground waters in the area.

**Aquatic Resources Measures**

**Fish Propagation**—Puget proposes to develop and implement a fish propagation facilities plan (FPFP) to support fish propagation and enhancement programs (Proposed Article 101). Puget would develop the FPFP through consultation with the ARG. Implementing the FPFP would necessitate construction of new facilities and modification of existing facilities to support fish propagation and enhancement programs. Construction activities that are expected for fish propagation facilities consist of the following: (1) Improving Spawning Beach 4 by separating the spawning beach chambers with concrete walls, installing separate water supply lines to each spawning beach chamber, and installing a sediment separator in the water supply lines. Puget also may need to stabilize the historical landslide to prevent the material from moving into the water supply for the spawning beach; (2) Expanding the hatchery facility at the Sulphur Springs site within the previously disturbed footprint; and (3) Decommissioning the

Upper Baker spawning beaches, which would likely include demolition of the existing water intake structure in Channel Creek and removal of all structures followed by creating a meandering side channel to Channel Creek.

Puget would conduct demolition and construction activities in a manner consistent with the water quality protection plan that will be developed under Proposed Article 401 to ensure limited adverse effects on water quality. Puget would select and implement best management practices for both in-water and upland activities. In-water work would be scheduled to occur during low-flow periods, and cofferdams would be used when and where necessary to segregate work areas from nearby surface waters. Removal of the Upper Baker spawning beach intake structure would occur when the creek is dry or during extreme low-water conditions when a shallow Super Sack cofferdam could easily be constructed and removed. The side channel would be constructed during the dry season, and its connection to Channel Creek would be expected to occur following completion of its construction. Other best management practices that may be implemented include: developing appropriately sized stormwater detention facilities; using appropriately sized equipment for demolishing the spawning beaches and constructing the side-channel; maintaining a dry environment around curing concrete; refueling in areas away from surface waters, mulching disturbed areas; and revegetating disturbed areas. Implementing these measures during demolition and construction activities would be expected to result in negligible contamination of surface waters by hazardous materials and short-term increases in turbidity. The extent of turbidity increases would be expected to be minor in most areas.

Under Proposed Article 101, the expanded rearing capacity of the fish propagation facilities at the Sulphur Springs site would not exceed 20,000 pounds for more than 3 months, which is the threshold level for requiring a NPDES permit. Although a NPDES permit would not be required for the facility, it would be operated in a customary manner for such facilities to ensure efficient production of fish while limiting the detrimental effects of discharges on water quality. Operating the expanded facility to meet higher fish production levels would result in increased use of formalin and feed and, consequently, would increase loads of formalin and nutrients discharged into Lake Shannon. Because of the size of Lake Shannon and the extent of the expected increases in load, the long-term effects on Lake Shannon water quality are expected to be negligible throughout the term of any new license issued.

**Upstream Fish Passage Implementation Plan**—To improve upstream fish passage, Puget would construct new facilities and renovate the existing facilities along the Lower Baker River (Proposed Article 103). It is anticipated that the improvements to the facility would require demolition of a portion of the trap, construction of a new water intake, and reconstruction of the trap. For all construction activities, Puget would control conditions in the work site in a manner consistent with the water quality protection plan that would be developed for Proposed Article 401 to minimize erosion and adverse

effects on water quality. In-water work would be scheduled to avoid periods when flood releases occur. A cofferdam would be used to segregate the work area from the remainder of the Baker River channel, and additional best management practices would be implemented to limit the adverse effects of construction on erosion and water quality.

**Connectivity between Lake Shannon and Baker Lake**—Under Proposed Article 104, Puget may construct and maintain a fishway to provide upstream passage for native char and other native fishes between Lake Shannon and Baker Lake. The design of this facility would be developed in consultation with the ARG. Construction of this facility would likely require in-water work to install a concrete sill in either the Baker River or Sulphur Creek channel for a picket weir. Puget would implement appropriate best management practices to limit the potential for construction of the facility to degrade water quality. Best management practices that are likely to be implemented include: restricting use of motorized vehicles within the stream channel; refueling offsite; conducting work in the dry when feasible; restricting in-water work to low-flow periods; and using cofferdams to segregate work areas from the remainder of the wetted channel.

**Downstream Fish Passage Implementation Plan**—To improve downstream migration of fish, Puget would construct and operate passage facilities for downstream migratory fish at the Upper Baker and Lower Baker developments using sequential development of FSC technology (Proposed Article 105). Implementing this measure would include preparation of launch sites on Baker Lake and Lake Shannon for the FSCs, fabrication and installation of FSCs for the Upper Baker dam and Lower Baker dam, and construction of acclimation facilities located near the confluence of the Baker and Skagit rivers.

Construction associated with improving downstream fish passage facilities would require disturbance of existing landforms; in-water construction; and the use, storage, and disposal of potentially hazardous materials. Performing these activities increases the short-term risk of erosion, introducing sediments to surface waters, and the potential for contaminating waters. By implementing protective measures in a manner consistent with the water quality protection plan that will be developed for Proposed Article 401, Puget would limit effects on water quality.

Puget would limit the potential for construction of the stress-relief ponds to result in erosion and adverse effects on water quality by conducting activities in a manner consistent with the water quality protection plan to be developed for Proposed Article 401. Puget would implement its best management practices, such as timing construction for the dry season, refueling offsite or in an area specifically designed for that purpose, limiting in-water work to the extent feasible, and protecting the disturbed area from erosion by commonly accepted methods.

**Large Woody Debris**—Under Proposed Article 109, Puget would transport LWD annually from project reservoirs to mutually agreeable stockpile areas in the Baker River basin. To accomplish this goal, Puget would annually collect LWD from the project reservoirs and develop a LWD Management Plan in consultation with the ARG and Terrestrial Resources Implementation Group (TRIG).

Currently, LWD accumulates along the log booms in both Baker Lake and Lake Shannon. Under the Proposed Action, we anticipate that LWD would similarly accumulate along the new log booms and that a boat may be used to corral the floating logs and tow them to the shore where a drag line or track hoe may be used to lift the LWD onto trucks for transport to stockpile areas. In accordance with the water quality protection plan developed for Proposed Article 401, Puget would implement best management practices to limit any adverse effects on erosion and water quality.

**Terrestrial Resources Measures**

**Osprey Nest Structures**—Implementation of Proposed Article 506 would result in Puget installing at least one artificial osprey nest structure at Lake Shannon. Puget may need to install one pole for each artificial osprey nest structure. Puget would implement the water quality protection plan in order to minimize adverse effects of these actions on erosion and water quality (Proposed Article 401). This protective measure would ensure that appropriate best management practices would be implemented to limit the potential for increasing turbidity and contaminating water with potentially hazardous materials used for the construction activity including in-water work.

**Loon Floating Nest Platforms**—Implementation of Proposed Article 507 would result in Puget installing and maintaining between three and six loon floating nest structures on the project reservoirs. Each floating loon nest structure, log booms surrounding each structure, and boundary buoys or other devices used to indicate restricted zones would need to be anchored in some manner. Additionally, Puget could decide to remove and reinstall some or all of these structures and store them offsite during periods other than April–July when they are required to be functional. Puget would install any necessary anchors and conduct maintenance activities in accordance with the water quality protection plan required under Proposed Article 401 to minimize adverse effects of these actions on erosion and water quality. It is anticipated that annual removal and reinstallation of the floating structures would result in negligible increases in turbidity.

**Recreational Resources Measures**

The Baker River Project attracts many day use and overnight recreationists to the area. To address the level of demand for recreation, several measures are included in the Proposed Action. Some of these measures have the potential to affect water quality. These activities could include: (1) constructing new trails and maintaining existing trails

and trail heads; (2) constructing and expanding campgrounds: (3) constructing day-use facility and a small-scale viewing facility; (4) constructing designated parking areas; (5) constructing a new boat launch; (6) redeveloping Baker Lake Resort, which could include removing buildings, boat dock, and fuel tanks at the resort and rehabilitating the area with native vegetation; (7) constructing floating log booms, buoys, or functionally equivalent structures to separate existing designated swimming areas from boat traffic; and (8) constructing and upgrading restrooms/toilet facilities.

*Effects Analysis*

Performing the activities listed above would have the potential to affect water quality. This would primarily occur by increasing erosion during ground disturbing activities, although there is also the potential to contaminate waters with fuel and other potentially hazardous materials used, stored and disposed of onsite. Puget would limit risks of degrading water quality through implementation of a water quality protection plan (Proposed Article 401). This would include adoption of appropriate best management practices for each activity. Installation and upgrading toilet facilities at dispersed camping sites could result in less human fecal matter near the shoreline of reservoirs, and could subsequently reduce the concentration of fecal coliform and disease-causing organisms in the near-shore environment.

#### 3.3.3.3 Unavoidable Adverse Effects

Major short-term increases in turbidity would likely occur for a few days to one month following connection of the new fish propagation side channel. There would be some circumstances that would result in localized elevated turbidity levels and the possibility of contaminating water with potentially hazardous materials associated with construction of the new upstream and downstream passage facilities. Operation of the stress-relief ponds would slightly increase the nutrient loads to the Lower Baker River, although these increases would have negligible effects on water quality in the Baker River because of its relatively high flow. With implementation of appropriate best management practices, we expect minor localized short-term increases in turbidity and negligible contamination from hazardous materials associated with Proposed Article 109 (LWD) throughout the new license term. Minor localized increases in turbidity could occur during and immediately following the associated construction period(s) for the osprey nest structures. Implementation of loon floating nest platforms measure is expected to limit turbidity increases to short-term minor localized events during and immediately following installation of the anchors.

#### 3.3.3.4 Cumulative Effects

Several human activities influence water quality in the Baker River basin and the Middle Skagit River including implementation of land management policies, recreation, Baker River Project operations, the interaction of Baker River flows with flows from the Upper Skagit River, and increasing development along the Middle Skagit River.

Based on current trends, we expect that demand for recreating in the Baker River basin and continued development along the Middle Skagit River would increase. Both of these foreseeable actions would have a potential to adversely affect water quality in the basin.

Under the Proposed Action, project operations would result in enhanced water quality conditions compared to current conditions. Operation of the two new 750-cfs turbines, along with increasing the minimum flow from 80 cfs to at least 1,000 cfs at the Lower Baker Development, is expected to reduce TDG concentrations in the Lower Baker River. Installation and maintenance of improved toilet facilities in areas near the reservoirs could reduce the occurrence of improper human waste disposal and thus reduce the extent of fecal coliform and disease-causing organisms near these sites. Baker Lake and Lake Shannon would generally be maintained at a higher elevation than under current conditions, which would reduce resuspension of sediments deposited in the reservoirs and subsequently turbidity along the drawdown zone of both the reservoirs. With a greater proportion of the flows coming off the surfaces of the reservoirs, as proposed with the FSCs, discharges from the forebays may be somewhat warmer and more turbid than under current conditions. Construction activities associated with modifications to the Lower Baker power plant, and implementation of enhancement measures for fish propagation, upstream and downstream fish passage, installation of artificial osprey nest structures and loon floating nest platforms, and recreation facilities could result in minor short-term localized increases in turbidity. However, implementation of the water quality protection plan would minimize these risks.

### 3.3.4 Aquatic Resources

The following sections describe the existing aquatic habitat and fish species occurring in the project vicinity. Additional information on federally listed threatened and endangered species (Chinook salmon and bull trout) is provided in section 3.3.6, Federally Listed Threatened and Endangered Species and Essential Fish Habitat.

#### 3.3.4.1 Affected Environment

**Aquatic Habitat Conditions**

For the purpose of characterizing existing aquatic habitat conditions, Puget defined the following three major basins and five subbasins: (1) Baker River Basin, composed of the Upper Baker River Subbasin (headwaters near RM 34 to RM 18.4), the Baker Lake Subbasin (RM 18.4 to RM 9.35), and Lake Shannon Subbasin (RM 9.35 to RM 1.2); (2) Lower Baker River Basin (RM 1.2 to RM 0.0), and the (3) Skagit River Basin, composed of the Middle Skagit River Subbasin (RM 56.5 to RM 24.5), and the Lower Skagit River Subbasin (RM 24.5 to RM 0.0) (R2 2003c). Puget described and quantified the amount of habitat currently or potentially accessible to anadromous and

adfluvial (lake-maturing) trout, char, and salmon in the tributary reaches upstream of the Lower and Upper Baker River developments.

**Baker River Basin**—The number of low-gradient streams is the primary difference among the three subbasins in the Baker River Basin. The Upper Baker River subbasin contains more accessible tributary habitat with gradients less than 2 percent than the combined total of the other two subbasins, and also contains more accessible side-channel and off-channel ponded habitat, which are very productive rearing areas for juvenile salmonids. The Baker Lake subbasin contains some off-channel habitat, whereas low-gradient side-channels and off-channel ponds are essentially lacking in the anadromous/adfluvial zone of the Lake Shannon subbasin. The Lake Shannon subbasin has the least amount of lower gradient tributary habitat. The subbasins also differ from each other because of the reservoir system. Baker Lake is estimated to be more productive for juvenile salmonids than Lake Shannon because the Baker Lake reservoir is larger, less turbid, and has more littoral (shallow edge) habitat than the Lake Shannon reservoir. The Upper Baker River subbasin also contains more accessible side-channel and off-channel ponded habitat than the other two Bake River subbasins

**Upper Baker River Subbasin**—The Upper Baker River subbsin includes approximately 15 miles of the mainstem from its headwaters near RM 34 downstream to the full-pool shoreline of Baker Lake at approximately RM 18.4 (R2, 2002). The major tributaries in this subbasin include Picket, Pass, Bald Eagle, Crystal, and Sulphide creeks (Puget, 1983b; Williams et al., 1975). Glacial melt from Mt. Shuksan to the north and Mt. Blum and Bacon Peak to the east influence flows in the Upper Baker River and many of its tributaries. The majority of the subbasin is within the North Cascades National Park, which is predominantly free of past human disturbances (Puget, 2002b).

From Pass Creek (approximately RM 31) to the headwaters, the stream habitat in the mainstem Baker River is dominated by steep gradients. Below Pass Creek, for the next 6 to 8 miles, the valley widens with stream widths ranging from 36 to 60 feet. Gradients through this reach are generally low with riffles and pools being the primary habitat types. Substrates are dominated by cobble, with gravels in many of the riffles (Williams et al., 1975).

From Sulphide Creek (RM 23) down to the confluence with Baker Lake the Upper Baker River channel has a low gradient. The floodplain is rather wide and the river frequently shifts and meanders along the valley floor. The stream channel becomes braided in this reach, especially near the confluence with Baker Lake, which is commonly referred to as the Upper Baker River delta. Substrate is composed mainly of gravel and cobble (Williams et al., 1975; R2, 2002).

Anadromous and adfluvial fish can access 14 tributaries to the Upper Baker River and the mainstem Baker River, up to a cascade located about 10.4 miles upstream of

Baker Lake, for a total of 20.5 miles of accessible habitat. A total of 15.3 miles of channel up to 4 percent gradient is the limit of tributary habitat available to spawning or rearing coho salmon. Most of this habitat (13.7 miles) is in large streams that could also potentially support spawning and rearing Chinook salmon, steelhead, and migratory native char. In addition, 2.4 miles of habitat in 4 to 8 percent gradient reaches are potentially suitable for adfluvial rainbow, anadromous/adfluvial cutthroat trout and resident native char production. Water temperatures in the Upper Baker River and many of its tributary streams are generally cold throughout the year. Glaciers feed many of the streams, resulting in seasonal increases in suspended solids from spring and summer glacial melt. Nutrient levels are generally low in the Upper Baker River, which may limit productivity (Forest Service, 2002a).

The Upper Baker River transports sediments and LWD from the upper watershed to Baker Lake, where the downstream movement of these materials is blocked. The Upper Baker River delivers the majority of the sediment delivered to Baker Lake each year.

**Baker Lake Subbasin**—The Baker Lake subbasin includes Baker Lake and its tributaries (excluding the Upper Baker River). Baker Lake is approximately 9 miles long and covers 4,980 surface acres at full pool. The major tributaries are Shannon, Boulder, Swift, Park, and Sandy creeks on the west side of the lake and Noisy and Anderson creeks, which flow from the east. Swift, Boulder, and Park creeks originate in glaciers on Mt. Baker. The other streams are non-glacial, although some of them have substantial snow packs that influence their hydrograph and water temperatures. Human development has not disturbed aquatic habitat in the majority of the Baker Lake tributaries, although road construction and past timber harvests in the Mt. Baker-Snoqualmie National Forest have affected some drainages. Past mining activities may have also affected habitat quality in some streams, such as Swift and Noisy creeks (Forest Service, 2002a).

At full pool, the reservoir has a shoreline perimeter of 35.6 miles. Water quality data collected in the Baker River suggest that the reservoir is oligotrophic (see additional discussion in Reservoir Water Levels section 3.3.2, Water Quantity Affected Environment).

Baker Lake stores sediments and LWD transported from the upper watershed. In addition to these materials, 280 pieces of LWD are contributed annually to Baker Lake from fallen trees along the reservoir margin and 66 pieces of LWD are transported from tributary streams. Currently, wood is removed from the reservoir only if it poses a possible operational or safety hazard. No large pieces of woody debris are passed downstream of Upper Baker dam (R2, 2003d). Baker Lake traps the vast majority of sediment delivered to the reservoir each year; approximately 88 percent of the incoming sediment load is trapped in Baker Lake. Fine, suspended sediments comprise the materials delivered downstream to Lake Shannon (R2, 2003e).

Resident and anadromous fish have access to portions of approximately 30 tributaries to Baker Lake. Steep gradients limit anadromous fish use of many of the streams. Approximately 10 streams have substantial sections with appropriate gradients for salmonid species. In the Baker Lake subbasin there is approximately 18.4 miles of stream length potentially accessible to anadromous or adfluvial salmonids, excluding the Upper Baker River. The total 7.9 miles of channel up to 4 percent gradient is the limit of tributary habitat available to spawning or rearing coho. Of this low gradient habitat, about one half (3.7 miles) is in large tributaries that could also potentially support spawning and rearing Chinook salmon, steelhead, and migratory native char. In addition, 4 miles of habitat in 4 to 8 percent gradient reaches are potentially suitable for adfluvial rainbow, anadromous/adfluvial cutthroat trout and resident native char production.

**Lake Shannon Subbasin**—The Lake Shannon subbasin is composed of Lake Shannon and its tributaries, including the major tributaries of Sulphur, Rocky, and Bear creeks on the west side of Lake Shannon. Lake Shannon is located approximately 1 mile downstream of Baker Lake. The reservoir is approximately 7 miles long (RM 1.2 to RM 8.2) and 1 mile wide, covering an area of 2,278 acres. Rocky Creek originates on Mt. Baker and is the only stream in this subbasin that receives glacial runoff. Lake Shannon is located in a narrower valley than the Baker Lake subbasin and most of the streams in the Lake Shannon subbasin are smaller than those in the Baker Lake subbasin. The shoreline of Lake Shannon is generally steep and there are few streams with large amounts of low-gradient habitats potentially accessible to anadromous/adfluvial salmonids.

At full pool, Lake Shannon has a shoreline perimeter of 27.3 miles. Lower Baker dam prevents the downstream transport of coarse sediment and much of the LWD from Lake Shannon and its tributaries. Woody debris in the reservoir are only removed if they pose an operational or safety hazard.

From the upper end of Lake Shannon (RM 8.2) to Upper Baker dam (RM 9.35), aquatic habitat is inundated as part of Lake Shannon during full-pool elevations, but during low-pool elevations a section of the river is exposed. The flow in this section of river is dependent on operations at the Upper Baker dam. Sulphur Creek and Rocky Creek are tributaries to this section.

Migratory fish have access to portions of approximately 22 tributary streams in the Lake Shannon subbasin, although the majority of these streams have rather steep gradients and are poor quality salmonid habitat. There are approximately 14.5 miles of stream length that are potentially accessible to anadromous or adfluvial salmonids in the Lake Shannon subbasin. The 3.7 miles of channel up to 4 percent gradient is the likely limit of tributary habitat available to spawning or rearing coho. Only 1.1 miles are in large tributaries that could also potentially support spawning and rearing Chinook

salmon, steelhead, and migratory native char. In addition, 2.6 miles of habitat in 4 to 8 percent gradient reaches are potentially suitable for adfluvial rainbow, anadromous/adfluvial cutthroat trout and resident native char production.

**Lower Baker River Basin**—The Lower Baker River consists of just over 1 mile of stream extending from Lower Baker dam (RM 1.2) down to the confluence with the Skagit River. This area can be divided into the following three reaches: (1) Lower Baker dam to the powerhouse (RM 0.9), (2) powerhouse to the barrier dam (RM 0.6), and (3) barrier dam to confluence with the Skagit River.

The barrier dam precludes upstream anadromous fish migration and directs fish to the Baker River adult trap facility. Much of the reach between the dam and the confluence with the Skagit River is inundated by backflow from the mainstem Skagit River, even during low flow conditions.

**Skagit River Basin**—The Baker River enters the mainstem Skagit River at RM 56.5 near the Town of Concrete. The Middle Skagit River subbasin is defined as the reach upstream of RM 24.5 to the confluence with the Baker River, while the Lower Skagit River subbasin consists of all reaches downstream of RM 24.5.

**Middle Skagit River Subbasin**—In the Middle Skagit River's gradient is generally low with predominantly riffle, glide, and pool habitat. This reach contains various sloughs and side channels that provide important resident and anadromous salmonid spawning and rearing habitat (Williams et al., 1975). Figure 3-14 presents weighted usable area (WUA) of habitat for various salmonids species that use the Middle Skagit River for spawning. Figure 3-15 presents WUA for Chinook and steelhead rearing habitat in the Middle Skagit River. This information was generated through habitat inventories and data collection at 23 transects in the Middle Skagit River as part of a relicensing study, conducted by R2 Resource Consultants.

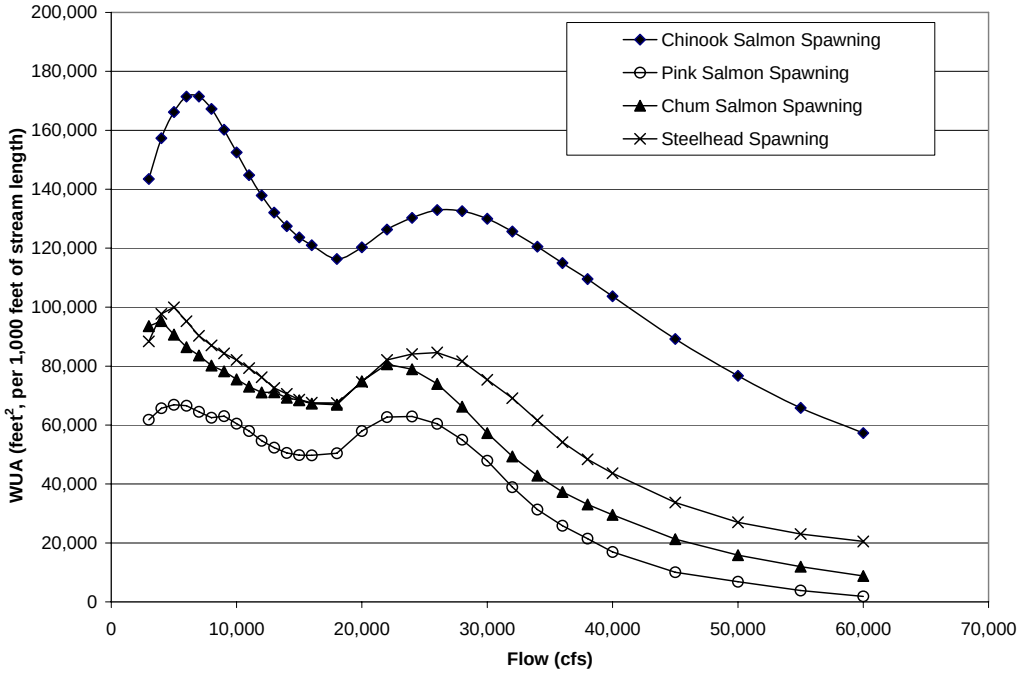



Figure 3-14. Spawning habitat WUA in the Middle Skagit River for Chinook, pink, and chum salmon and steelhead trout.

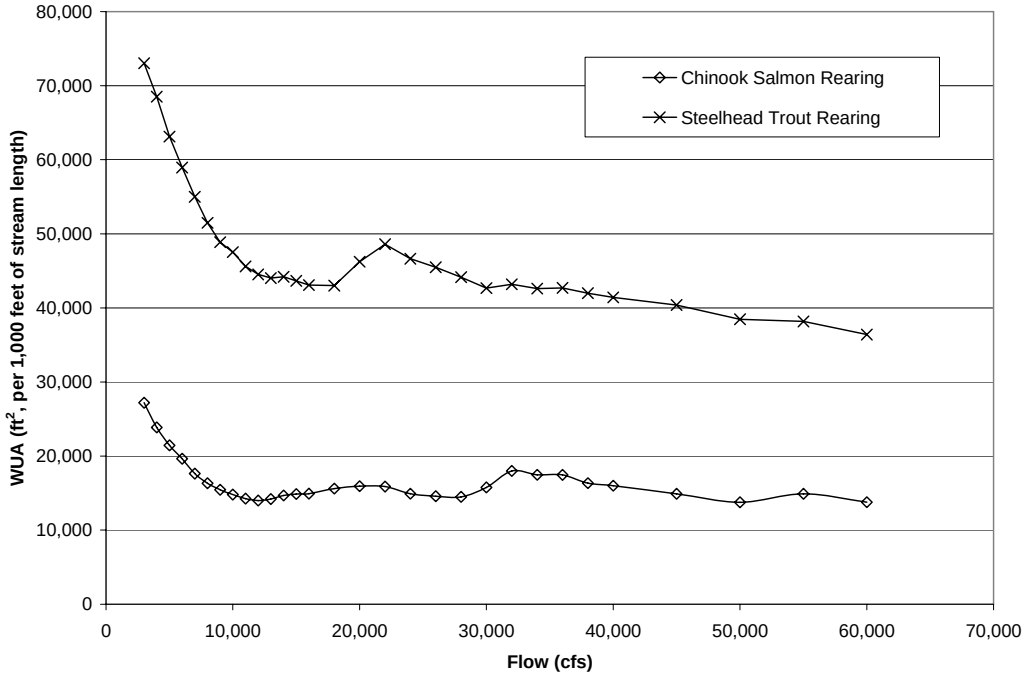



Figure 3-15. Rearing habitat WUA in the Middle Skagit River for Chinook salmon and steelhead trout.

**Lower Skagit River Subbasin**—The Lower Skagit River has a low gradient. Before the Skagit River enters the Skagit Bay estuary, it splits into a north and south fork

in addition to numerous sloughs. Human development increases along the shores of the Skagit River in these lower reaches. Past and ongoing human disturbances in the Lower Skagit River have led to the degradation of aquatic habitat. Off-channel habitat and tributary streams, which are critical components of juvenile salmonid rearing habitat, have been the most heavily affected (Bishop and Morgan, 1996; Beechie et al., 1994).

Channelization associated with flood control activities in the Lower Skagit River also has degraded mainstem aquatic habitat (Bishop and Morgan, 1996). Much of the Lower Skagit River is a single, modified channel (Smith et al., 2003). More than 60 percent of the historical Skagit River tidal wetlands and estuarine areas have been lost, primarily due to conversion to agricultural lands (Dean et al., 2000; City of Seattle, 2001). These estuarine areas provide important juvenile salmonid rearing habitat.

Stream flows from both the Baker River Project and the Skagit River Project affect habitats in the Lower Skagit River (see discussion of Baker River Flows and Skagit River Flows in section 3.3.2.1 Water Quantity, Affected Environment).

**Anadromous Fish Species**

The following eight species of anadromous salmonids occur in the Baker River Project area: sockeye (*Oncorhynchus nerka*), coho (*O. kisutch*), Chinook (*O. tshawytscha)*, pink (*O. gorbuscha*), and chum salmon (*O. keta*), steelhead (*O. mykiss*), native char (*Salvelinus* sp.), and coastal cutthroat trout (*O. clarki*). It is unknown whether anadromous native char spawn in the Baker River watershed, and therefore, native char are discussed in the Resident Fish Species section provided in subsequent sections of this EIS.

Coho and sockeye are the most abundant salmon stocks returning to the adult fish trap with the remaining species comprising only about 7 percent of the total trap returns (table 3-12).

Table 3-12. Species composition of adult anadromous salmonids returning to the Baker River Project, 1926–2003. [a]

| Species | Average | Percent of Total | Minimum | Maximum |
|---|---|---|---|---|
| Sockeye | 3,332 | 32 | 99 | 20,236 |
| Coho | 6,140 | 60 | 187 | 26,549 |
| Chinook | 222 | 2 | 0 | 1,453 |
| Steelhead | 180 | 2 | 0 | 929 |
| Pink | 340 | 3 | 0 | 6,123 |
| Chum | 19 | 0 | 0 | 185 |
| Coastal cutthroat trout[b] | 5 | 0 | 1 | 17 |
| Native char[b] | 19 | 0 | 7 | 40 |

[a] Source: License application.
[b] Data from 1995–2003.

**Sockeye Salmon**—The Baker River sockeye population has been a focus of fisheries management for over 100 years and is believed to be the only remaining native sockeye population in the Puget Sound Region (Forest Service, 2002a). Management of sockeye fisheries in the Baker River system is under the jurisdiction of WDFW and Tribal interests. Currently, sockeye salmon in the Baker River system are included on the Forest Service Regional Forester's Sensitive Animal list. The sockeye run comprises about 32 percent of total anadromous salmonid returns to the system (table 3-12). The WDFW considers the Baker River population a distinct stock on the basis of its geographic separation from other sockeye runs and its genetic characteristics (WDFW and WWTIT, 1994).

Anecdotal estimates of historical escapement suggest that the maximum run size ranged from approximately 10,000 to 20,000 adults (Kemmerich, 1945; Skagit System Cooperative [SSC], 1996). Prior to construction of Upper Baker dam, sockeye in the basin were primarily beach spawners, using areas of upwelling along the original Baker Lake. The majority of the historical sockeye spawning habitat was inundated with the completion of Upper Baker dam in 1959.

As mitigation for the loss of spawning habitat, Puget constructed three artificial sockeye spawning beaches (Spawning Beaches 1, 2, and 3) to provide for continued sockeye production in the Baker River system. In addition, a fourth artificial spawning beach (Spawning Beach 4) was constructed in 1990 to replace the other beaches. Currently, only Spawning Beaches 3 and 4 are actively used. The beaches provide spawning habitat for approximately 4,500 adults. Spawner success and fry survival is considerably higher in the spawning beaches than in the wild. When adult returns to the Baker River are forecasted to exceed the capacity of the spawning beaches, fish are released directly into Baker Lake.

Adult sockeye return to the Baker River basin from June through August, with peak returns in July (table 3-13). Spawning at the artificial beaches generally occurs from late September through December, peaking from late October to late November (WDFW and WWTIT, 1994). Adults normally spend 2 to 3 years rearing in the ocean prior to returning at a size of 4 to 8 pounds (Puget, 2002b). Adult sockeye returns to the Baker River trap from 1926 to 2002 ranged from a low of 99 to a maximum of 15,991, with an average of 3,115. A new record escapement was established in 2003, with 20,236 adult sockeye returns as of December 31, 2003. Since 1994, adult sockeye returns to the Baker River have increased substantially to an annual average of 7,803 sockeye, with record escapements occurring in 6 of the last 10 years. NMFS conducted an evaluation of the Baker River population and on March 25, 1999, ruled that the species did not warrant ESA protection because adult returns had increased substantially.

Table 3-13. Baker River anadromous salmonids periodicity chart. (Source: Adapted from Puget, 2002b)

| Species and Life History | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sockeye** | | | | | | | | | | | | |
| Adult immigration | | | | | | | | | | | | |
| Juvenile emigration | | | | | | | | | | | | |
| **Coho** | | | | | | | | | | | | |
| Adult immigration | | | | | | | | | | | | |
| Juvenile emigration | | | | | | | | | | | | |
| **Chinook** | | | | | | | | | | | | |
| Adult immigration | | | | | | | | | | | | |
| Juvenile emigration | | | | | | | | | | | | |
| **Steelhead (summer)** | | | | | | | | | | | | |
| Adult immigration | | | | | | | | | | | | |
| Juvenile emigration | | | | | | | | | | | | |
| **Steelhead (winter)** | | | | | | | | | | | | |
| Adult immigration | | | | | | | | | | | | |
| Juvenile emigration | | | | | | | | | | | | |
| **Pink** | | | | | | | | | | | | |
| Adult immigration | | | | | | | | | | | | |
| Juvenile emigration | | | | | | | | | | | | |
| **Chum** | | | | | | | | | | | | |
| Adult immigration | | | | | | | | | | | | |
| Juvenile emigration | | | | | | | | | | | | |
| **Anadromous Coastal Cutthroat** | | | | | | | | | | | | |
| Adult immigration | | | | | | | | | | | | |
| Juvenile emigration | | | | | | | | | | | | |

Notes: Black – Peak migration period.
Gray – Span of run timing.

Sockeye fry produced at the spawning beaches emerge from spawning gravels from February through late May or early June. At the upper spawning beach, fry are able to volitionally outmigrate to Baker Lake. At Spawning Beach 4, fry volitionally exit the spawning beaches and enter a holding area, and are then trucked to Baker Lake for release.

The majority of sockeye juveniles rear in Baker Lake for 1 to 2 years, although some may remain in freshwater for well over 3 years (Mazumder, 2004). Approximately 90 percent of juvenile sockeye outmigrants from Baker Lake are less than 3 years in age.

According to Puget (2002b), outmigration of sockeye smolts from the Baker River occurs from the end of March through July, peaking from mid-May to mid-June (table 3-13). Over the past 11 years, total juvenile sockeye counts at the project

downstream migrant traps have averaged about 125,800, with a peak of 194,955 sockeye in 2001 and a low of 25,848 in 1993.

Based on analysis from Mazumder (2004) of data for nutrients and zooplankton, Baker Lake productivity is currently not limited by nutrients and the concentration of nutrients is at or above average levels observed among some of the most productive sockeye systems. Large Baker Lake sockeye smolt sizes and high biomass of large zooplankton suggest that the current carrying capacity of Baker Lake has not been reached for sockeye production, yet adult return percentages have been lower than expected given the large smolt sizes (Mazumder, 2004).

**Coho Salmon**—Coho salmon are native to the Skagit River drainage. The WDFW has identified two stocks of coho in the basin: Skagit and Baker (WDFW and WWTIT, 1994). Skagit River adult coho generally spawn in tributary streams, although some spawning may occur in side channels and sloughs along the mainstem Skagit River. Coho juveniles may be present throughout the year in the Lower Skagit River, rearing in pools and off-channel habitat (WDFW and WWTIT, 1994). Based on escapement and commercial catches, total Skagit River adult coho run size was estimated to range from 17,100 to 127,000 (average of 54,100 fish) from 1985 to 2001(Pacific Fishery Management Council [PFMC], 2003; WDFW, 2002a). Because of declines in escapement numbers in the 1980s and early 1990s, WDFW considers this stock to be depressed (WDFW and WWTIT, 1994).

Coho salmon from the Baker River have been considered a separate stock from Skagit River coho because of their smaller size at maturity, and because they historically had an earlier adult run timing. Adult Baker River coho salmon tend to weigh only about 3 to 4 pounds compared to the 6- to 7-pounds for Skagit River coho salmon (Puget, 2002b; WDFW and WWTIT, 1994). The current life history periodicity for Baker River stock coho salmon is shown in table 3-13.

Based on trap counts from 1926 to 2002, coho escapement to the Baker River averaged 6,139 adults, with a high of 26,549 in 1962 and a low of 187 in 1928. Most adult coho collected at the Baker River trap are transported upstream and released into Baker Lake, although some are transported to the Sulphur Creek facility to be used as broodstock for artificial propagation. Coho spawning generally occurs from October through January. Spawning ground surveys show that coho spawn in the Upper Baker River and its tributaries (Egan, 1978; Puget, 2002b).

Baker River coho juveniles rear in the stream and lake habitats for 1 to 2 years. Coho smolts migrate to the ocean from March to August, with peak migration occurring in May and June (table 3-13) (Puget, 2002b).

Using potential habitat area as an indicator, estimates of total Baker River system coho smolt production potential was estimated between 100,000 and 150,000 fish (Johnson, 1986; Beechie et al., 1994). Juvenile counts at the Baker River gulpers averaged 48,989 coho smolts from 1987 to 2002. These numbers do not include smolts that may have passed over project spillways and turbines or residualized in the lake.

Artificial propagation has influenced coho production in the Baker River system. Clark Creek coho from the Skagit River basin were released for many years into the Baker River system. Since the mid-1990s, coho returns to the Lower Baker River trap have been used as broodstock for a voluntary supplementation program. An average of about 115,000 artificially produced Baker River coho were released from the Sulphur Creek facility into the Baker River system annually from 1994 to 2001.

Management of coho fisheries in the Baker River system is under the jurisdiction of WDFW and Tribal interests. Coho salmon in the Baker River system are included on the Forest Service Regional Forester's Sensitive Animal list.

**Chinook Salmon**—Chinook salmon are the largest of the Pacific salmon species. Some individuals weigh over 100 pounds, although most adults weigh less than 40 pounds (Meehan and Bjornn, 1991). The Skagit River supports the largest natural run of Chinook salmon in the Puget Sound (WDFW and WWTIT, 1994). The WDFW has identified six distinct Skagit River Chinook stocks, including two summer runs (Upper Skagit Mainstem/Tributaries and Lower Sauk), three spring runs (Upper Sauk, Suiattle, and Upper Cascade), and one fall run (Lower Skagit Mainstem/ Tributaries) (WDFW and WWTIT, 1994). The total Skagit River adult Chinook run size was estimated to range from 5,200 to 26,400 fish from 1985 to 2001, with an average of about 14,175 adults (PFMC, 2003). In recent years, Chinook salmon returning to the Baker River have primarily been spring Chinook that are part of an experimental program, although some fish from the Lower Skagit River fall Chinook stock also have been observed in the trap. The first returns for the experimental program were in 2002. The majority of the Skagit River Chinook spawn in stream reaches located upstream of the Baker River confluence.

The Lower Skagit fall Chinook run spawns primarily in the mainstem Skagit River and tributary streams between the Sauk River confluence and Newhalem, excluding the Upper Cascade River (WDFW and WWTIT, 1994). Periodicity of Chinook and other salmonids that are known to spawn in the Middle Skagit River are summarized in table 3-14. Based on spawning surveys, adult escapement for the period from 1986 to 2001 ranged from 409 to 4,584, with an average of 1,967. In general, adult escapement levels have tended to be lower in odd years than in even years, which may attributed to incidental catch of Chinook in pink salmon fisheries, biennial differences in production, or other unknown factors (WDFW and WWTIT, 1994). Because of a long-term negative trend in escapement numbers, WDFW classified this Chinook stock as depressed (WDFW and WWTIT, 1994).

Table 3-14. Periodicity chart for anadromous salmonids known to spawn in the Middle Skagit River.

| Species/Lifestage | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chinook spawning[a] | | 10 25 | 31 | 15 | | | | | | | | |
| Chinook incubation[b] | | | | | | | | | | | | |
| Chinook peak alevin[c] | | | | | | | | | | | | |
| Chinook fry <50mm[b] | | | | | | | | | | | | |
| Pink spawning[a] | | 10 20 | 20 | | | | | | | | | |
| Pink incubation[b] | | | | | | | | | | | | |
| Pink peak alevin[c] | | | | | | | | | | | | |
| Pink fry <50 mm[b] | | | | | | | | | | | | |
| Chum spawning[a] | | | 15 | 1 | 5 31 | | | | | | | |
| Chum incubation[b] | | | | | | | | | | | | |
| Chum peak alevin[c] | | | | | | | | | | | | |
| Chum fry <50 mm[b] | | | | | | | | | | | | |
| Steelhead spawning[a] | | | | | | | | 15 | 11 | 15 31 | | |
| Steelhead incubation[b] | | | | | | | | | | | | |
| Steelhead peak alevin[c] | | | | | | | | | | | | |
| Steelhead fry <50 mm[b] | | | | | | | | | | | | |
| Steelhead yearlings | | | | | | | | | | | | |

Notes: Light gray–Total time period for that life stage.
Dark gray–Peak timing.

[a] R2 (2003f).

[b] Results are compiled from annual counts of screw-trap data reported by Seiler et al. (2002); electrofishing surveys reported in Stober et al. (1982), Jones & Stokes (1985),and Beck and Associates (1989). Information has been excerpted from R2 (2003g).

[c] Assuming 30 days prior to peak abundance of newly emerged fry.

During the initial years of operation, adult Chinook returning to the Baker River trap were transported to Baker Lake. In 1995, the WDFW recommended elimination of adult Chinook transported to Baker Lake because it decided adults would have higher reproductive potential if they were returned to the Skagit River (Puget, 2002c).

In the Baker River, juvenile Chinook outmigration occurs from March through August, peaking in June and July (table 3-13). Over the past 11 years, an average of 1,303 juvenile Chinook salmon have been collected and transported downstream of the Baker River Project annually.

The WDFW began introducing spring Chinook, with an early adult migration pattern, into the Baker River watershed in 1999. The intent of the experimental program is to determine if these Chinook are able to take advantage of habitat in and above the Baker River reservoirs (Puget, 2002c). The WDFW will be monitoring the contribution of the 4,889 spring Chinook adults released since 1999 in an effort to evaluate the success of the experimental program (BRC, 2002a).

Six Chinook stocks migrate through the lower portion of the Skagit River downstream of the Baker River confluence, which is influenced by the project. Each stock has exhibited declines in spawner escapement from the 1970s to early 1990s; however, spawner escapement of all stocks increased from 1997 to 2001. All stocks are above the NMFS critical escapement threshold. All six of these Chinook stocks are maintained by wild production, although some hatchery programs exist.

Four Chinook hatchery programs currently exist in the Skagit River basin: the Skagit River summer Chinook, Skagit River fall Chinook, Skagit Hatchery spring Chinook, and the Baker River spring Chinook. Spawning, incubation, and early rearing of all four stocks takes place at the Marblemount Hatchery. Total release targets by stock include fall Chinook fingerlings (220,000), spring Chinook fingerlings (250,000), summer Chinook (200,000), and yearling spring Chinook (150,000). All hatchery programs use Skagit River basin stocks (HSRG, 2003).

Chinook salmon spawn in approximately 270 miles of the Skagit River and its tributaries (NMFS, 2003). The Lower Sauk Chinook spawn primarily from the mouth of the Sauk River to RM 21, separate from the Upper Sauk spring spawning areas above RM 32. The Upper Sauk Chinook spawn above RM 32 in the main stem and in the Whitechuck River and its tributaries. The Suiattle Chinook population spawns in the mainstem and several tributaries.

Descriptions of harvest rates for Skagit River stocks are provided in NMFS (2003). Recovery exploitation rates have been set at 49 percent for the Lower Skagit River population, 51 percent for the Lower Sauk River population and 60 percent for the Upper Skagit River population (NMFS, 2000a). Total fishery exploitation rates on the

Skagit and Sauk River summer and fall populations are estimated to have averaged 60 percent from 1983 through 1996, and 29 percent from 1997 through 2000. Actual recent 5-year mean harvest rates for individual Skagit River basin Chinook stocks have ranged from 30 to 63 percent (WCSBRT, 2003).

**Steelhead Trout**—Three summer steelhead and three winter steelhead stocks have been identified in the Skagit River basin (WDFW and WWTIT, 1994). Winter steelhead returning to the Baker River drainage belong to the Mainstem Skagit/Tributaries (Mainstem Skagit) stock (WDFW and WWTIT, 1994). Escapement of the mainstem Skagit River winter steelhead stock ranged from 3,780 to 13,194 from 1985 through 2001, with an average of about 8,150 adults (WDFW, 2002a). The WDFW considers the mainstem Skagit winter steelhead stock to be healthy, because, on average, escapement meets the goal of 6,000 adults (WDFW, 2002a; WDFW and WWTIT, 1994).

The timing of the Baker River winter and summer steelhead life cycles are shown in table 3-13. Winter steelhead trout are a native species and are thought to have historically used areas primarily below Baker Lake for spawning (Puget, 1983c). Winter steelhead trout return to the Baker River from September through April. Summer steelhead adults have also been captured at the Baker River trap from April through August.

**Pink Salmon**—The Skagit River supports a single pink salmon stock that primarily uses the mainstem Skagit River and Sauk River. Spawning generally occurs from Newhalem (RM 93) downstream to Sedro-Woolley (RM 23), with the heaviest amount of spawning concentrated in the mainstem Skagit River from Marblemount (RM 78) upstream to Newhalem. The Skagit River pink stock is the largest spawning stock in Washington State, with total run sizes ranging from 117,700 to 1,426,600 (average of 784,120 fish) from 1985 to 2001 (PFMC, 2003). The WDFW considers this stock to be healthy (WDFW and WWTIT, 1994).

An average of 347 pink salmon adults have been collected each year at the Baker River trap since 1926. Adults normally arrive at the trap from August through November, with the peak migration occurring in October (table 3-13).

**Chum Salmon**—-The WDFW defines three stocks of Skagit River chum salmon: Mainstem Skagit, Sauk, and Lower Skagit Tributaries (WDFW and WWTIT, 1994). The Mainstem Skagit stock spawns in the mainstem Skagit River and larger tributaries from Newhalem (RM 93) downstream at least as far as Lyman (RM 34). Spawning primarily occurs from mid-November to late December, peaking in late November or early December. Skagit River chum tend to spawn in side channels or protected mainstem areas (WDFW and WWTIT, 1994).

Small numbers of chum salmon began returning to the Baker River traps starting in 1972 (only one adult was documented at the traps prior to that year). An average of 21 adult chum have been collected at the Baker River trap over the last 31 years. When adult chum are observed at the trap, they normally arrive from late September through December, with peak returns in November (table 3-13) (Puget, 2002b).

**Coastal Cutthroat Trout (Sea-run)**—The WDFW has identified the Skagit River coastal cutthroat as a separate stock, based upon the geographic distribution of their spawning grounds. The watershed supports all life-history forms including anadromous, adfluvial, fluvial, and stream residents. All forms of cutthroat in the basin are considered native and are maintained by wild production (Blakley et al., 2000). There are no data regarding the total production, catch, or escapement for anadromous coastal cutthroat trout in the Skagit River. A rough estimate of approximately 13,000 returning spawners was observed in 1997 (Johnson et al., 1999). Because of the limited information regarding the abundance of coastal cutthroat in the Skagit River drainage, WDFW considers the status of the stock as unknown (Blakley et al., 2000).

The Baker River is known to support at least adfluvial and stream resident coastal cutthroat trout, which are described in greater detail in the following section. The status of anadromous cutthroat in the Baker River system is not fully understood, as documentation of adult collections at the Baker River trap has only been kept since 1995. From 1995 to 2000, 18 adult cutthroat were collected at the trap. Adult coastal cutthroat trout migrate into the Baker River sporadically throughout the year, but primarily in October and November (table 3-13).

Management of coastal cutthroat trout fisheries in the Baker River system is under the jurisdiction of WDFW and Tribal interests. Baker River cutthroat trout are included on the Forest Service Regional Forester's Sensitive Animal list.

**Pacific and River Lamprey**—Pacific and river lamprey both exhibit anadromous life history strategies. Upon hatching, larvae (ammocoetes) reside for several years in fine silt deposits in quiet backwater areas of streams.

Anadromous lamprey historically had access to the Baker River at least as far upstream as Baker Lake. It is not known whether adult Pacific or river lamprey enter the adult collection facility, although no fish have been transported above Lower Baker dam since 1929. There have been no confirmed Pacific or river lamprey observations in the Baker River basin upstream of Lower Baker dam (R2, 2003h).

**White Sturgeon**—White sturgeon have historically had access to the Baker River. Sturgeon primarily inhabit large river systems and can be found holding in deep pools in the Lower Skagit and Snohomish rivers (R2, 2003h). Adult sturgeon spend time rearing in estuarine and marine environments and spawn in freshwater during the spring. The

historical presence of white sturgeon in the Baker River system has not been confirmed, and no adults have been captured for transport upstream of the Lower Baker dam.

**Resident Fish Species**—Fifteen species of resident fish have been confirmed in the Baker River system. These include five species of native game fish, six species of native non-game fish, three species of non-native game fish, and one species of non-native, non-game fish (table 3-15). The abundance of many of these fish is not known.

Table 3-15. Resident fish species confirmed present in the Baker River Project area.

| Common Name | Scientific Name | Status |
|---|---|---|
| Native char | *Salvelinus* spp. | Native, common |
| Rainbow trout | *Oncorhynchus mykiss* | Native, common |
| Coastal cutthroat trout | *Oncorhynchus clarki* | Native, common |
| Kokanee (sockeye salmon) | *Oncorhynchus nerka* | Native, common |
| Mountain whitefish | *Prosopium williamsoni* | Native non-game fish, common |
| Salish sucker[a] | *Catostomus catostomus* subspecies, undescribed | Native, uncommon |
| Three-spine stickleback | *Gasterosteus aculeatus* | Native non-game fish, uncommon |
| Torrent sculpin | *Cottus rhotheus* | Native non-game fish, common |
| Prickly sculpin | *Cottus asper* | Native non-game fish, common |
| Coastrange sculpin | *Cottus aleuticus* | Native non-game fish, common |
| Largescale sucker | *Catostomus macrocheilus* | Native non-game fish, common |
| Eastern brook trout | *Salvelinus fontinalis* | Non-native, common |
| Brown trout | *Salmo trutta* | Non-native, uncommon |
| Lake trout | *Salvelinus namaycush* | Non-native, uncommon |
| Pumpkinseed | *Lepomis gibbosus* | Non-native, uncommon |

[a] Only observed in the Skagit River, not in the Baker River watershed.

**Native Char (Bull Trout/Dolly Varden)**—The Coastal/Puget Sound bull trout distinct population segment (DPS) was designated threatened under the ESA on November 1, 1999 (64 FR 58910). ESA critical habitat was proposed for the Coastal/Puget Sound DPS by the FWS on June 24, 2004, which includes habitat in the Baker River watershed.

Historically, bull trout occurred throughout the Puget Sound region. Their historical distribution has been significantly reduced. Currently, bull trout persist in isolated populations of headwater streams; however, migratory components still exist in some local populations. The Coastal/Puget Sound bull trout DPS encompasses all Pacific Coast drainages within the coterminous United States north of the Columbia River, and includes 34 subpopulations, 15 of which occur in the Puget Sound analysis area, and four that occur in the Skagit River basin. Adult population size is highly variable, ranging up to 10,000 spawners per year throughout the Skagit River basin. The decline of the Coastal/Puget Sound bull trout DPS has been attributed to habitat degradation, migration

barriers, interaction with introduced species, water quality degradation, and past management practices.

McPhail and Taylor (1995) concluded that the two char show all the attributes of classic subspecies. For this reason, WDFW manages bull trout and Dolly Varden as a single management unit (Kraemer, 1996). Although the distribution of bull trout and Dolly Varden is largely unknown in Puget Sound river basins, limited preliminary data suggest bull trout predominate in mainstem river systems and reservoirs and Dolly Varden are stream residents (McPhail and Taylor, 1995; Baxter et al., 1997; Hagen and Taylor, 2001; Taylor et al., 2001). Fisheries managers assume that all native char observed in the Baker and Skagit rivers are bull trout in order to be conservative on the side of bull trout conservation.

Throughout their range, bull trout are primarily freshwater species that exhibit both resident and migratory life-history patterns. The entire lifecycle of the resident bull trout takes place in headwater streams. Resident fish spawn, rear, and live as adults generally in one headwater stream, although short migrations may occur. Migratory bull trout spawn and rear in headwater streams, then after 2 to 4 years rearing in their home stream, juveniles migrate downstream to larger rivers (fluvial) or lakes and reservoirs (adfluvial) where they grow to maturity. Migrations can range from a few miles to well over 50 miles (Goetz, 2002). Mature adults migrate back upstream to spawn in headwater reaches. There is increasing evidence that several coastal populations have an anadromous component in Washington (Rieman and McIntyre, 1993; Kraemer, 1994; Goetz, 2002; Volk, 2000).

Anadromous char have been documented in the Puget Sound region and in the Skagit River, although the distribution within the marine environment, migration timing, and proportion of populations that exhibit anadromy is poorly understood.

Bull trout spawning occurs in the fall from late August into December (timing varies based on local conditions) and is thought to be correlated with antecedent flows, water temperatures, and photo period. In the Baker River basin, spawning primarily occurs in October. Bull trout spawning generally occurs when water temperature drops below 9°C. In western Washington, 95 percent of bull trout spawning occurs above an elevation of 1,000 feet or in streams with very cold temperatures similar to high elevation streams (WDFW, 1998). Mature adult bull trout can spawn more than once in a lifetime. First spawning is often noted after age four, with individuals living 10 or more years (Rieman and McIntyre, 1993).

Bull trout appear to have more specific habitat requirements than other salmonids (Rieman and McIntyre, 1993), requiring cold clean water and a high degree of habitat complexity. Habitat characteristics including water temperature, stream size, stream gradient, substrate composition, hydraulic complexity, and large wood have been

associated with bull trout distribution and abundance (Dambacher et al., 1992; Rieman and McIntyre, 1993).

The Bull Trout Recovery Team reviewed the distribution of Skagit River basin subpopulations, and bull trout within the Baker River basin are now considered to be part of the Lower Skagit River subpopulation. The Lower Skagit River bull trout subpopulation is the only one considered "strong" by the FWS in the Puget Sound analysis area based on the estimated subpopulation size of 8,000 to 10,000 adult fish (50 CFR Part 17). Bull trout from this stock tend to spawn in the upper reaches of tributary streams above approximately 1,000 feet in elevation, and the mainstem Skagit River downstream of the Baker River confluence is not considered spawning habitat, but is considered foraging, migration, and overwintering habitat (69 FR 122, page 35790; FWS, 2004e).

Very few quantitative data regarding native char abundance are available for the Baker River basin. Since 1995, an average of 19 native char per year have been collected at the adult trap and released into Baker Lake. Sampling has failed to confirm the presence of native char in the 0.6 mile reach between the barrier dam and Lower Baker dam.

Between 1994 through 2003, an average of 10 juvenile native char were counted at the Baker River Project downstream passage facilities. Large native char are frequently observed holding at the entrance to the downstream fish passage facilities in both reservoirs during the spring, presumably feeding on outmigrating salmonids. Large native char are also reported to congregate immediately below Upper Baker dam during the spring (Puget, 2002d).

The majority of char production is thought to come from tributaries to Baker Lake, although juvenile char have been observed in tributaries to Lake Shannon (Puget, 2002d). Many tributaries to Lake Shannon are relatively warm, but juvenile char have been observed in tributaries that feed into the lower reservoir. In comparison to Lake Shannon tributaries, several Baker Lake tributaries have cold, glacial origins and support relatively larger native char populations. However, during various electrofishing surveys native char were found in only two of these tributaries.

Adult native char have been observed in the mainstem Skagit River downstream of the Baker River confluence. This reach is primarily considered to be a migration corridor between upstream spawning habitat and the Skagit River estuary and Puget Sound.

The Upper Baker River appears to support a larger native char population compared to Lake Shannon. Large native char, up to 30 inches in length, were observed in the Upper Baker River during habitat surveys conducted in the fall of 2001 and 2002.

These fish were presumed to be adfluvial adults migrating into the Baker River from Baker Lake to spawn.

Electrofishing surveys in 1992 also indicated numerous juvenile native char in side channels near Pass Creek, immediately downstream of RM 28. Downstream passage of native char from Baker Lake to Lake Shannon was confirmed through mark/recapture site observations.

During November 2000, the FWS conducted surveys of the Upper Baker River delta and approximately 1.9 miles of stream habitat above the delta. The researchers observed eight native char and two redds during three surveys. One of the native char observed was holding near a redd in the mainstem river immediately above the delta, and the researchers concluded that the area was located in the drawdown zone (FWS, 2001).

Only one estimate, based on direct observations, has been made of native char densities in the Baker River watershed. An electrofishing study in Sulphur Creek resulted in density estimates of 0.0018 native char per square foot. This density estimate was for more than one year-class. Recent snorkel surveys suggest that spawner abundance in Sulphur Creek is lower than observed in the Upper Baker River.

Between 1987 and 1992, native char made up less than 1 percent of the recorded opening day catch. Over the 6-year period, 20 native char were caught on the opening day of fishing in Baker Lake out of a total of 2,939 fish (catch rate of 0.7 percent), and 4 native char were caught in Lake Shannon out of a total of 3,266 fish (catch rate of 0.1 percent).

**Rainbow Trout**—Rainbow trout have similar biology and habitat requirements to the anadromous steelhead component of the species. Rainbow trout are native to the Baker River watershed and are found in both project reservoirs in addition to many of the tributary streams. These fish remain in fresh water for their entire lives and therefore reach smaller sizes at maturity than anadromous steelhead.

As part of the recreational fishery in the Baker River system, rainbow trout have been stocked annually into Baker or Depression lakes since 1968 through a cooperative effort between Puget and WDFW. Non-native rainbow trout stocking was discontinued in Baker Lake in 2002, in favor of releases only to Depression Lake.

**Coastal Cutthroat Trout**—Resident coastal cutthroat trout are also native to the Baker River system and share the same general biology and habitat requirements as the anadromous component of the species. Cutthroat trout have been found in both project reservoirs and numerous tributary streams.

Resident cutthroat trout generally spawn from January through April in the upper portions of tributary drainages. Most juveniles have emerged from the gravel by mid-spring, where they rear for approximately 1 year before moving downstream to larger streams or lakes (Wydoski and Whitney, 1979).

**Kokanee**—The biology and distribution of kokanee salmon are similar to that of the species' anadromous component, the sockeye salmon. The U.S. Bureau of Fisheries' (now FWS) reports suggested that the Baker River kokanee stock became established only after the creation of Lake Shannon. Beginning in 1927, large numbers of kokanee were observed in the Baker Lake System. In subsequent years after completion of the Upper Baker dam in 1956, it was also observed that whenever there was limited overflow at Upper Baker dam during juvenile outmigration periods, above average numbers of sockeye would remain in Baker Lake (Puget, 1983b).

Adult kokanee usually reach smaller sizes at maturity in comparison to sockeye salmon, as lake environments are generally less productive than the ocean (Meehan and Bjornn, 1991). There have been no formal studies to quantify the abundance of kokanee in Baker Lake.

In the Baker River system, kokanee are believed to spawn in some of the smaller tributaries of Baker Lake and immediately downstream of the Upper Baker dam (Puget, 2002b). In general, kokanee mature and migrate into their natal streams from late August through October, with peak spawning occurring from September through late October.

From 1934 to 1940, an average of 228,500 kokanee was released in Lake Shannon. Since 1995, WDFW has resumed releases of kokanee into Lake Shannon, planting approximately 97,000 to 343,000 fry per year.

**Salish Sucker**—The Salish sucker is a Forest Service sensitive species. The confluence of the Baker and Skagit rivers is one of a few locations where this species has been found in Washington (McPhail and Taylor, 1999). The Salish sucker is currently a scientifically undescribed fish that is closely related to the longnose sucker. The Salish sucker is known only to be found in the Fraser River valley of British Columbia and in a few Washington State Puget Sound tributaries. Populations of Salish suckers in British Columbia have been declining, and this species has been extirpated from some areas that it previously inhabited.

Although the Salish sucker is listed as endangered in Canada, McPhail and Taylor (1999) state that "the Salish sucker is unlikely to go extinct in Washington State in the near future.

### Aquatic Invertebrates and Plankton

Benthic macroinvertebrates include a variety of aquatic insects, annelids, mollusks, crustaceans, and flatworms inhabiting the bottom of a watercourse. Benthic macroinvertebrates are a major food source for fish and other aquatic organisms in streams and lakes, and their diversity and abundance is an important indicator of water quality and aquatic ecosystem status. In addition to benthic macroinvertebrate, plankton communities in Baker Lake and Lake Shannon are important components of the biological food web in project waters. In addition to being important food resources for aquatic organisms, such as fish, benthic macroinvertebrates and plankton are important components of the food web for amphibians, birds, mammals, and other terrestrial invertebrates. Many invertebrate species act indirectly as agents in nutrient recycling within stream and reservoir ecosystems (Black et al., 2001).

**Plankton**—Information about plankton resources in the Baker River watershed is summarized from the Baker Aquatic and Sockeye Salmon Productivity study (Mazumder, 2004).

Zooplankton and phytoplankton are the base of aquatic food webs in reservoirs and lakes and are the predominant diet of juvenile sockeye salmon and many lake/reservoir dwelling organisms. The zooplankton community composition and size distribution are excellent indicators of juvenile sockeye predation on zooplankton and these measures are also good indicators of the growth potential of juvenile sockeye to the smolt stage. The macro- zooplankton community of Baker Lake is similar taxonomically to other clear water lakes that support sockeye salmon rearing (Edmundson and Mazumder, 2001).

Zooplankton density has increased consistently from less than 2,000 to more than 5,000 organisms per cubic meter, and biomass increased from 10 mg per cubic meter to greater than 30 mg per cubic meter from years 1984 to 2000. Summer average density and biomass of zooplankton were significantly higher than the annual averages, suggesting that the summer months (May to September) provide much greater sockeye food resources than the remaining months of the year. The total zooplankton density and biomass measured in Baker Lake fall within the range of productive sockeye lakes (Mazumder, 2004). Daphnia and Diaptomous were the next two most dominant taxa. On average, Daphnia contributed about 15 to 20 percent of total zooplankton biomass, which can be considered as excellent for a sockeye lake (Mazumder, 2004). The percent contribution of Diaptomous to total zooplankton biomass also indicates that the predation pressure on large zooplankton is not intense and that the lake is under carrying capacity for producing sockeye smolts.

**Benthic Macroinvertebrates**—This group of bottom dwelling organisms cycle nutrients in their aquatic environment by feeding on algae and organic detritus and by

preying on a wide range of small organisms. Benthic macroinvertebrates are an important food resource for fishes, amphibians, reptiles, birds and mammals.

In studies conducted by the National Park Service for several tributaries to Baker Lake during 2000 to 2002, a total of 131 taxa were observed from 9 major taxonomic groups (21,848 individual organisms were counted). Ephemeroptera, Plecoptera, and Trichoptera accounted for 67 percent of taxa observed (n = 131 taxa) within the watershed.

**Existing Fish Facilities and Programs**

As part of the existing license for the Baker River Project, Puget is required to provide upstream and downstream fish passage and operate spawning beaches for sockeye production. In addition to these programs, Puget also operates the Sulphur Creek hatchery facility, where voluntary production and rearing programs are conducted.

**Adult Fish Passage**—Adult upstream passage is provided at the Baker River Project through the use of a trap-and-haul fish transport system.

The system at the Baker River Project is operated as a four-step process.

(1) A tailrace barrier (barrier dam) along with attraction flow (80 cfs) is used to guide the adults from the river into the trapping facility, where they are directed into two holding pools, each 40 feet by 15 feet.

(2) A crowder system is then used to force the adults from the holding pools into a sorting and counting facility.

(3) Adults selected for transport are crowded using a vertical crowder (brail) and moved into the hopper pond. The hopper is a steel tank that holds approximately 1,000 gallons of water. The hopper is then lifted by crane, and the fish-laden water is transferred into a transport truck equipped with aeration and oxygen diffusers.

(4) After loading, the fish are transported to release locations in the basin based on management objectives dictated by treaty tribes and WDFW for the species being transported. For fish transported to the Upper Baker facilities, total transport time is approximately 20 to 25 minutes.

The current Baker River Project upstream adult trap-and-haul facilities are located at RM 0.6 and have been in operation since 1957. The major fish species transported or collected at the Baker River trap include coho, sockeye, Chinook, steelhead, pink, chum, and native char. On average, about 10,000 anadromous fish are transported yearly from this facility. The most fish transported in any year since 1926 was 30,269 fish in 1962.

From 1995 to 2002, an average of 19 adult char was also collected each year at the facility, and transported and released upstream of the Upper Baker River Project (Puget, 2002d). In general, the adult passage facilities operate year-round with the exception of a brief maintenance repair period that occurs in May or June.

**Juvenile Fish Passage**—Downstream migrating fish are able to pass project facilities through spillways, turbines, and juvenile fish collection facilities. Juvenile fish passage facilities are located both at Upper and Lower Baker dams. The facilities at both projects are similar in design and function. However, juvenile facilities at Lower Baker dam are smaller than those at Upper Baker dam. The juvenile passage systems function as follows:

(1) Full-depth barrier nets direct fish away from turbine openings and guide downstream migrating fish into a juvenile fish collection barge, referred to as the gulper. The nets are constructed of 0.25-inch square mesh netting that extends completely across and to the bottom of the forebay.

(2) The gulper is a FSC equipped with a pumping system that provides the flow needed to attract downstream migrants to the entrance of the FSC. Total flow into the Upper Baker gulper is 130 cfs. The entrance of the FSC is 12 feet wide and extends approximately 9 feet below the surface of the water.

(3) The water and fish entering the FSC encounter a set of wooden louvers that are used to separate the fish from the flow. The louvers act as a fish behavioral device that directs migrants up into a 3-foot-wide chute that leads them to the FSC.

(4) Captured juveniles are sampled for biological information, counted, transferred to a tank trailer and trucked to the mouth of the Baker River where they are released.

Besides size, other differences between the juvenile facilities at Upper Baker and Lower Baker exist. Upper Baker has more pumping capacity through the gulper, has a larger collection trap, was the first to have full depth nets, and loads fish at the head of the dam. Lower Baker captures fewer fish, has a smaller-scale collection trap, and barges fish to shore for transport. With most of the fish production coming out of Baker Lake, the focus has been to make the Upper Baker downstream capture system the most effective possible.

From 1987 to 2001, the average number of downstream migrants collected at Upper and Lower Baker was approximately 127,000 and 13,000, respectively. The juvenile fish passage facilities generally operate from March through July. When these facilities are not in operation, downstream migrants may pass through the project via spillways and turbines.

Hydroacoustic data from Baker Lake, used to quantify fish entering the turbine intakes versus those that enter the juvenile collection facility, indicated that 71 percent of fish used the bypass facilities from 1988 to 1995.

Based on mark-recapture studies conducted from 1992 to 2002, approximately 53 percent of juveniles used the Baker Lake FSC, while 23 percent used the Lake Shannon FSC. The numbers presented for the two FSCs are not true efficiency values because natural residualization and mortality associated with juvenile passage through the reservoirs affects the numbers available for capture at each FSC. It was noted that approximately 2 percent of the marked coho released in Upper Baker over this same period was collected at the Lower Baker FSC, indicating that some juveniles are able to successfully migrate past the project through turbines or spill.

**Spawning Beaches**—To replace inundated sockeye spawning habitat at Baker Lake, WDFW, with funding from Puget, created three spawning beaches at the upper end of Baker Lake. Sockeye salmon Spawning Beaches 1, 2, and 3 were constructed in 1957, 1959, and 1966, respectively. Spawning Beach 1 was simply a test facility with the capacity for 100 spawning adults and was decommissioned in 1965. In addition, Spawning Beach 2 has not been used since 1994.

Spawning Beach 3 is an artificial pond approximately 100 feet by 150 feet with a designed capacity of 1,500 sockeye. Approximately 5 to 10 cfs of water is diverted from Channel Creek to supply the pond. A series of pipes underneath the spawning beach distributes the water, which percolates through the gravel to simulate natural sockeye spawning areas. Adult sockeye collected at the Baker River trap are delivered to the beaches and allowed to spawn naturally. After emergence, fry tend to spend between 10 to 14 days at the beach before volitionally migrating to Channel Creek and ultimately to Baker Lake (Quistorff, 1960). Egg-to-fry survival rates at the upper spawning beaches have been quite high, ranging from 25 to 95 percent and averaging about 61 percent, which is substantially higher than what would be expected in the wild (Puget, 2002e).

Because of concern that the migrating Upper Baker River channel would eventually reclaim the spawning beach facility, Spawning Beach 4 was constructed in 1990 at the Sulphur Creek facility. Spawning Beach 4 is also an artificial pond measuring 200 feet by 150 feet. The pond uses approximately 10 cfs of water, which is provided by a series of springs. Water is distributed using a similar system to the previous beaches, which allows inflow to percolate through the gravels to mimic natural spawning conditions.

Spawning Beach 4 has a standard capacity of 3,400 adults. In 2003, the upper limits of capacity were tested with 3,750 adults. After a couple of years of initially poor survival due to sedimentation associated with slides at the water intake, egg-to-fry

survival rates have been comparable to those observed at the upper spawning beaches. From 1993 to 2000 survival rates based on estimates of fecundity ranged from 40 to 74 percent with an average of about 57 percent. Fry emerging from the gravel at Spawning Beach 4 are allowed to volitionally exit the beaches where they are held at a collection structure until they are transported to Baker Lake and released at various locations.

Originally Spawning Beach 4 was a single unit. However, because of concerns regarding an IHN virus outbreak in 1994, the beach was divided into four isolated compartments, each measuring 50 feet by 150 feet. Currently, if the IHN virus infection is detected in one of the compartments, the effluent can be diverted for chlorination treatment in accordance with the disease management protocol for the facility. Spawning adults carry the virus to the facility (BRC, 1999). In recent years, efforts have been made to remove adult sockeye from the spawning beaches earlier in the season in an attempt to avoid IHN virus transmission to emerging sockeye fry. Since the early removal of adults has been initiated, incidences of IHN virus infection have been dramatically reduced (BRC, 2002b). Efforts at reducing adult density in Spawning Beach 4 were also attempted, although no causal link was established between density and incidences of IHN virus infection (BRC, 2001).

The Upper Baker River channel has not yet caused the forecasted destruction of the Spawning Beach 3 facility. Therefore, as an attempt to spread the risk of production failures due to disease or other unforeseen events at Spawning Beach 4, the BRC has decided to continue using Spawning Beach 3.

Spawning Beach 3 is now operated as an unattended facility. In recent years, low flows in Channel Creek have led to concerns regarding the adequacy of water being supplied to the beach in dry years. A special-use permit issued by the Forest Service to Puget requires that Spawning Beaches 1, 2, and 3 be formally decommissioned when they are no longer needed. As Spawning Beach 3 remains in operation, no actions have been taken toward decommissioning.

Currently, after sockeye adults spawn and die at spawning beaches 3 and 4, the carcasses are distributed to select streams to provide marine-derived nutrients to enhance primary production. Carcasses pulled from beach 3 and 4 are dumped off the bridges into Sandy, Park, Swift, and Shannon creeks. Numbers of fish carcasses placed at each location are recorded each year. Since the spawning beaches began operation, an average of about 1,355,000 sockeye fry have been produced each year at these facilities.

**The Sulphur Creek Facility and Voluntary Fisheries Programs**—The Sulphur Creek facility, located downstream of Upper Baker dam along Sulphur Creek, was constructed in the 1970s. It is used for sockeye, coho, and rainbow trout propagation. The facility consists of a large rearing pond, five raceways, five circular ponds, and several work/storage sheds. Puget and WDFW staff operate the facilities.

Puget has also been voluntarily rearing coho salmon since 1981. In the early years of the program, coho fry were transferred from WDFW's Marblemount hatchery on the Skagit River and raised in the raceways at the Sulphur Creek facility. Beginning in 1987, the program was expanded to also include coho rearing in the net pens on Lake Shannon.

In addition, a cooperative rainbow trout stocking program has been conducted voluntarily between WDFW and Puget since 1968. WDFW provides the rainbow trout fingerlings and Puget rears them at the Sulphur Creek facility. In the past, these fish were primarily planted in Baker Lake, with small numbers occasionally released in Lake Shannon and Depression Lake. Beginning in 2002, all of the rainbow trout produced (18,792) were released into Depression Lake to avoid potential adverse interactions with native fish in Baker Lake.

The Skagit System Cooperative, in conjunction with Puget, also conducted a voluntary steelhead rearing program from 1987 to 1998. The program used steelhead fry transported from Skagit River hatcheries. These fish were raised at the Lake Shannon net pens until they were released as smolts.

In 2002, Puget and WDFW constructed an egg incubation building at the Sulphur Creek facility as part of a sockeye supplementation pilot program and to safeguard against production losses from IHN-related mortality at the spawning beaches. The structure is approximately 27 feet long by 12 feet wide and uses water from the same spring as Spawning Beach 4. The facility uses approximately 0.07 to 0.08 cfs. Funding for the facility is provided by Puget, and the WDFW oversees operations.

The purpose behind the incubation program is to provide an additional option for sockeye production in years when the spawning beaches do not meet production goals in the event of an IHN virus outbreak. The program would produce 1 million sockeye fry. If full spawning beach production goals are met and there is no IHN virus disease outbreak triggering disinfection, then one-half of the fry produced would be released in Lake Shannon and one-half in Baker Lake. If the IHN virus is detected, then 75 percent of the fry produced at the incubation facility would be released in Baker Lake and 25 percent released in Lake Shannon. These fish would be released as unfed fry (BRC, 2002a).

### Fish Harvest

Anadromous fish from the Baker River are subject to all of the same fisheries affecting Skagit River stocks, from terminal area fisheries in the Skagit River and Skagit Bay to Pacific Ocean fisheries. However, there is limited information that relates directly to the commercial harvest of Baker River fish, as estimates tend to be for the Skagit River basin as a whole. For example, the PFMC estimated that between 1990 and 2000

commercial net catches in the Puget Sound took an average of about 7,750 coho, 1,340 Chinook, and 263,000 pink salmon that originated from the Skagit River (PFMC, 2003). By comparing Skagit River coho escapement estimates and Baker River adult trap returns with harvest numbers, Puget estimated that an average of approximately 840 Baker River coho were harvested each year in the Puget Sound commercial fishery from 1990 to 2000 (WDFW, 2002a; PFMC, 2003).

Since 1987, Puget has conducted angler surveys on both reservoirs, normally during the opening day of fishing season. These surveys have found that in Baker Lake, kokanee and residual sockeye comprise the vast majority of the fishery, generally ranging from about 85 to 98 percent of the catch. Coho are the second most caught species in Baker Lake comprising about 1 to 5 percent of the catch in most years. Rainbow trout catches were also observed in most years, but at substantially lower numbers than coho, kokanee, and residualized sockeye. The Lake Shannon fishery displays the same basic species catch distribution. Kokanee and residualized sockeye generally make up about 85 to 95 percent of the fishery, followed by coho at about 1 to 15 percent, and then rainbow trout. In both reservoirs, Chinook salmon, cutthroat trout, and native char are also caught in low numbers. The catch per unit effort for anglers on Baker Lake has ranged from 0.35 to 2.08 fish/angler-hour, while Lake Shannon catch per unit effort has ranged from 0.34 to 2.79 fish/angler-hour.

Since the 1970s, WDFW has also conducted periodic angler surveys at Baker Lake; however, these data have not been formally compiled and the raw data sheets could not be summarized for this analysis.

**Environmental Impacts and Recommendations**

The Settlement Agreement and the amended license application contain proposed license articles that address water quantity issues in the Baker and Skagit Rivers and both project reservoirs. FWS, NMFS, FS, WDFW, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community, recommend that the Commission approve the Settlement Agreement and that Puget implement the proposed license articles. The following sections describe the measures proposed by Puget and the agencies, as well as our analysis of the proposed measures on aquatic resources in the project area.

In addition to the measures contained in the Settlement Agreement, WDFW and NMFS made several additional recommendations that are addressed in section 5.2, Fish and Wildlife Agency Recommendations. Our final recommendations on those measures are made in section 5.1, Comprehensive Development and Recommended Alternative.

#### 3.3.4.2 Environmental Effects

The effects of reservoir level management and project releases on aquatic resources in the Baker River Project area are described below. The following effects

analyses rely heavily on analyses and figures presented in sections 3.3.2.2, Water Quantity, Environmental Effects and 3.3.3.2 Water Quality, Environmental Effects. Effects analysis of project releases also relies heavily on hydrologic and habitat modeling. A major hydrologic and habitat modeling effort (HYDROPS and post-processing), conducted by Puget and R2 Resource Consultants, was completed for each alternative for the Lower Baker and Skagit River downstream of the Baker River confluence as part of the collaborative process to reach settlement on the operational strategy. HYDROPS output for current conditions and the Proposed Action were used in flow routing and habitat models (termed "post-processing" for this analysis) to estimate the effect of each alternative on several habitat parameters and metrics for the five representative energy years. Post-processing generated estimates of operational effects on ramping, quantity of various habitat types, and the size of the varial zone (water fluctuation zone) in the Middle/Lower Skagit River. The post-processing estimates are summarized in the appropriate effects analysis section where applicable (i.e., varial zone estimates are summarized in the Redd Dewatering and Aquatic Invertebrates analysis sections).

In addition to post-processing output for the five representative energy years (termed level-3 output), level-4 output was also produced using the hydrograph from 12 consecutive energy years from 1991 to 2002, which includes the five representative energy years. Level-4 output was used to double check preferred operational scenarios and assumptions from level-3 output. Level 4 output is also provided in subsequent analyses where applicable.

**Reservoir Level Management**

As presented in the Reservoir Level Management discussion of section 3.3.2.2, Water Quantity, Environmental Effects, reservoir water levels fluctuate as a result of current project operations (No-Action Alternative) and would also fluctuate under the Proposed Action. These fluctuations have the potential to affect water quality, such as DO concentrations, water temperature, TDG, and turbidity in the reservoirs, as well as in the Lower Baker River and Skagit River downstream of the Baker River confluence. Changes in water quality and bank erosion can affect aquatic habitat quality and quantity and also fish spawning.

Three proposed articles included in the Proposed Action would affect reservoir elevations. Proposed Article 106, Flow Implementation, is based on aquatic, recreational, and cultural resource needs, as well as human health and safety, property and project economic and operational issues. Proposed Article 107 is associated with flood storage and is based on the continuation of an existing agreement and potential for an expansion of Puget's flood control agreement with the Corps. Proposed Article 401 restricts drafting Baker Lake and Lake Shannon below elevations of 685 feet and 389 feet msl,

respectively, to limit the likelihood of resuspending fine sediments that have deposited in the reservoirs.

Flood control operations are discussed in section 2.2.2. Under the Proposed Action, the reservoir management regime described in Proposed Article 106(C), Flow Implementation, would reduce the duration of exposure of the reservoir inundation zone by delaying the start of fall drawdown and accelerating spring refill. The use of reservoir storage at the Baker River Project for flood storage under the Proposed Action would remain under the direction of the Corps.

As discussed in section 3.3.2.2, Water Quantity, Environmental Effects, operating the project under the Proposed Action would result in delayed fall drawdown and earlier spring refill of the reservoir in comparison with Current Operations in Baker Lake. Baker Lake water levels would tend to remain higher than Current Operation levels approximately 70 percent of the time, although the modeled differential remained less than 4 feet (see section 3.3.1.2). The Proposed Action would result in little change in daily water level fluctuations of Baker Lake compared to current conditions.

The Proposed Action would also tend to result in Lake Shannon water levels that are higher than current conditions a little more than half the time and would somewhat reduce the frequency of daily water level fluctuations in the 1-foot to 5-foot range (see section 3.3.1.2). In April and May, Lake Shannon water levels would be more variable under the Proposed Action than under current conditions.

Input received during the collaborative relicensing process highlighted the importance of reducing the resuspension of fine sediments in Lake Shannon and reducing redd-dewatering at tributary mouths of Baker Lake caused by reservoir drawdown. Questions were raised through the collaborative process concerning the effects of reservoir management on the euphotic zone, aquatic invertebrates and plankton, and spill events. We present effects analyses for reservoir level management with regard to effects on water quality, euphotic zone, fish habitat and redd dewatering, aquatic vertebrates and plankton, and spill events in the sections below.

**Water Quality**—Reservoir level fluctuations can affect water quality by increasing bank erosion and resuspending fine sediments that have accumulated along the reservoir margins. Reservoir fluctuations can also affect DO concentrations, turbidity levels, and water temperatures (section 3.3.3.1, Water Quality Affected Environment). Water quality degradation can have many effects on fish and other aquatic organisms ranging from stress to mortality.

*Effects Analysis*

Under Current Operations, TDG levels can rise above state standards (section 3.3.3.1). Compared to Current Operations, turbidity events may be less frequent under the Proposed Action, and TDG in the Lower Baker River would be reduced. The water quality monitoring program would result in the identification of water quality problems and result in feasible remedies. This would be beneficial to aquatic resources because elevated TDG concentrations can negatively affect juvenile fish survival and elevated turbidity could cause negative effects such as siltation of salmonid spawning grounds in the Middle Skagit River. Elevated turbidity could also cause chronic and acute stress response in fish species, lower juvenile fish survival, interfere with adult migration, and cause direct mortality at very high levels.

Under the Proposed Action, the water quality monitoring plan would allow for the continued study of and early identification of potential water quality problems caused by the project and would facilitate remedies to these problems over the term of the new license. Effects on aquatic resources under the Proposed Action would be minimized because potential water quality problems would be addressed by operational or technical solutions.

**Euphotic Zone**—Reservoir fluctuations in Baker Lake and Lake Shannon can affect the euphotic zone (the zone that light penetrates). Lake and reservoir primary production is primarily driven by phytoplankton production. The depth that light penetrates into the water column and reservoir surface area determines the volume of water available for phytoplankton production, since phytoplankton need light to conduct photosynthesis. Therefore, the euphotic zone is a good indicator of primary production potential, with the assumption that a lake system would be more productive as the euphotic zone increases.

*Effects Analysis*

R2 Resource Consultants estimated euphotic zone volume for the 5 energy years for both Lake Shannon and Baker Lake. The Proposed Action would result in an increase in Baker Lake euphotic zone volume for all five representative years compared to Current Operations, but would result in a very slight decrease of Lake Shannon for 2 of the 5 energy years. However, the combined weighted average Lake Shannon euphotic zone volume would be slightly more than under Current Operations. Overall, the Baker Lake euphotic zone volume would increase approximately 8 percent under the Proposed Action compared to current conditions. The Proposed Action should result in an increase of primary production in Baker Lake because the euphotic zone volume would increase, which would benefit all aquatic species, and may result in increased fish production.

**Fish Habitat and Redd Dewatering**—Reservoir fluctuations in Baker Lake affect potential salmonid spawning habitat for bull trout, coho, and sockeye salmon.

Redds constructed in tributary delta areas are subject to dewatering caused by reservoir drawdown, scour during channel migration, or inundation during subsequent reservoir refill (FWS, 2001; SSC, 1996). Many tributary streams have habitat accessible to anadromous/adfluvial salmonids in Baker Lake and Lake Shannon, although the majority of this habitat is in Baker Lake tributaries.

Although the majority of native char spawning is thought to occur in tributary streams located a considerable distance above Baker Lake, it is possible that some char may spawn in the deltas of tributaries that flow into Baker Lake (R2, 2003i). Fourteen tributaries to Baker Lake have habitat in the drawdown zone that native char could potentially use for spawning, but only a few tributary delta areas provide potential char spawning habitat in Lake Shannon (R2, 2003i).

Excess sockeye salmon adults that are not transferred to the artificial spawning beaches are released into the Baker Lake system to spawn naturally. SSC (1996) conducted a study in 1994, when 12,653 adult sockeye were released into Baker Lake, and found that 26 percent of natural sockeye spawning in Baker Lake occurred within the drawdown zone and the Upper Baker River delta. SSC (1996) estimated that at least one-third of all redds constructed in the drawdown zone in 1994 were dewatered, which was equal to approximately 9 percent of all redds counted. There is some indication that drawdown zone timing can influence the proportion of redds constructed in the drawdown zone. The 2 years with the highest proportion of redds in the drawdown zone were years in which drawdown started before October 1. Of particular note is that the spawning beach program was initiated to mitigate for effects on sockeye spawning habitat caused by the construction and operation and of the Baker River Project. Actual use of this habitat by other salmonid and native fish species is largely unknown, although spawning by other salmonids has been documented in tributary drawdown zones and rearing/foraging also occurs.

*Effects Analysis*

The following effects analysis focuses on sockeye, for which data are available; however, the general analysis is also applicable to potential bull trout and coho salmon spawning impacts. SSC (1996) suggested that if Baker Lake is drawn down to its minimum surface elevation prior to sockeye spawning (mid-September), lake-spawning sockeye would have only habitat that would remain continually wetted for spawning, which would substantially reduce the potential for sockeye redd dewatering.

Although early drawdown may decrease redd dewatering, other negative effects may be caused by early drawdown (table 3-16). Similarly, later drawdown has benefits and consequences to aquatic resources (table 3-16).

Table 3-16. Aquatic resource effects of early or late reservoir drawdown.[a]

| Positive Effects | Negative Effects |
|---|---|
| **Aquatic Resource Effects of Early Drawdown** | |
| Avoid scour/dewatering due to change in base level | May encourage additional spawning in drawdown zone[b] |
| Increase stability of spawning habitat during spawning season | Reduces storage available for downstream low flow augmentation |
| Isolate effects of reservoir pool changes | Increases length of exposed stream channel |
| Greater flexibility to time downstream releases | Increases risk of high-flow related scour |
| **Aquatic Resource Effects of Late Drawdown** | |
| May discourage spawning in the drawdown zone[b] | Unavoidable scour and dewatering of redds within drawdown zone |
| Increases storage available for downstream flow augmentation | Increases the probability of spill |
| Decreases length of exposed stream channel during spawning season | Continued risk of high-flow related scour |

[a] Source: Study A-15, *Upper Baker Delta Scour*, presentation at ARWG meeting on August 8, 2003.

[b] The 2 years with the highest proportion of redds in the drawdown zone were years in which drawdown started before October 1.

Although early drawdown may protect redds from being dewatered, Baker Lake fluctuates substantially in elevation during the winter and spring under all scenarios, primarily due to flood control operations. Sockeye fry do not emerge until February to May or early-June; therefore, redds constructed in drawdown stream habitats may be exposed to reservoir inundation before eggs hatch and fry emerge. Redds constructed in the drawdown zone would be inundated if the reservoir level rises above the spawning level and potentially scoured during high flow events. Inundation by reservoir water could reduce intergravel flow, which provides oxygen to incubating eggs and also removes metabolic waste products that can be toxic to eggs. In addition, inundation can lead to siltation, which could smother incubating eggs and alevins. Unless the reservoir level remained nearly constant from the spawning through incubation period, redds would either be subject to dewatering or inundation due to water level fluctuations.

Spawner abundance fluctuates from year to year and spawning distributions of fish change over time, possibly due to shift in habitat. Yearly hydrologic variation can also cause shifts in spawning distribution. In some years, higher percentages of fish may spawn in the drawdown zone, while in other years more spawning may occur outside the drawdown zone. Therefore, it is not possible to estimate the actual number or percentage of redds that may be dewatered in a given year. Only the amount of habitat affected in the drawdown zone can be quantified.

Under Current Operations, approximately 14 percent of all tributary habitat (linear distance) accessible to anadromous/adfluvial salmonids above Upper Baker dam is

located in the Baker Lake drawdown zone, and 8.2 percent of accessible tributary habitat in Lake Shannon is located in the drawdown zone. Over 80 percent of the drawdown zone habitat in both reservoirs is less than 4 percent in gradient (lower gradients are more preferable for fish spawning and rearing), but not all of the low gradient tributary drawdown habitat reaches have appropriate substrate for spawning. Many of these reaches are dominated by sandy or silty substrates that are not good spawning habitat. The Proposed Action would slightly reduce the total amount of tributary habitat subject to drawdowns when compared to Current Operations since the regulated minimum reservoir elevation for Baker Lake would be approximately 8 feet above Current Operations regulated minimums and Lake Shannon would be approximately 15 feet above Current Operations regulated minimums.

In summary, fish spawning occurs in the drawdown zones of the project reservoirs and reservoir fluctuations affect spawning habitat and fish redds in the drawdown zone. If the reservoirs are drawn down early, redds created in the drawdown zone could be inundated later during incubation by reservoir water when the reservoir refills to detain peak runoff as part of the Corps flood control agreement, which would be a negative effect. If the reservoirs are drawn down later, redds would be subject to dewatering and would also be subject to later inundation during peak runoff events, which are negative effects. Redds under any scenario would be subject to scour caused by down cutting as the reservoir recedes and scour caused by high stream flows during peak runoff, which are negative effects. Since early drawdown and late drawdown both have a separate set of benefits and consequences regarding fish spawning effects and the lake levels are not changing substantially, we conclude that the overall general effect of the Proposed Action on spawning would be similar or slightly improved compared to Current Operations.

Based on relicensing study results, the vast majority of spawning bull trout have been observed upstream of the drawdown zone (see Resident Fish Species discussion in section 3.3.4.1). Therefore, drawdown effects on bull trout redds under the Proposed Action are expected to be minimal. Currently, the majority of sockeye production occurs at the artificial spawning beaches, and only excess sockeye from the spawning beach program are released to spawn naturally in Baker Lake.

**Aquatic Invertebrates and Plankton**—Reservoir fluctuations may impact aquatic invertebrates and plankton. The construction of Upper and Lower Baker dams inundated a large area and changed the hydrologic cycle of the Baker River. These changes may have affected invertebrate life cycles and communities that evolved over time. Further, facilities at the project may act as barriers and prevent either downstream movement or dispersal upstream (Vaughn, 2002).

*Effects Analysis*

As described in section 3.3.4.1, Affected Environment, there appears to be an abundance and diversity of aquatic macroinvertebrates in tributaries to Baker Lake, although similar data are not available for Lake Shannon. In addition, zooplankton biomass and diversity appears to be at or above the levels of other productive sockeye salmon lakes (Mazumder, 2004). Although wide seasonal fluctuations in reservoir levels would occur within both Lake Shannon and Baker Lake during similar times of the year under the Proposed Action and Current Operations, the total reservoir drawdown zone would decrease and the euphotic volume would increase under the Proposed Action. An increased euphotic zone would increase primary productivity and the forage base for aquatic invertebrates and zooplankton.

**Spill Events**—Reservoir management in combination with downstream releases can affect spill event frequency and magnitude. Spill can flush fish over the dams. A substantial portion of fish spilled over the dams may not survive. During the 1950s, researchers identified that sockeye smolts passing over the spillway at Lower Baker dam sustained a mortality rate of 54 percent (Hamilton and Andrew, 1954). Therefore, alternatives that increase the number and volume of spill events would increase negative effects on fish populations.

*Effects Analysis*

HYDROPS post-processing estimated that the average number and volume of yearly spill events over the Lower Baker dam under Current Operations would be 3.7 spill events at 846,194 million acre-feet and 3.11 spill events at 494,429 million acre-feet under the Proposed Action. Upper Baker dam spill events would be reduced from an average of 0.81 spill event per year under current conditions to 0.58 spill event under the Proposed Action. Therefore, modeling predicts that the Proposed Action would decrease the number and volume of spill events compared to Current Operations. Reducing the number and volume of spill events under the Proposed Action should decrease the likelihood of spilling migrating juvenile salmonids over the dams, thereby reducing fish mortality.

Under the Proposed Action, springtime reservoir refill must be completed much earlier compared to Current Operations. Based on daily reservoir pool level data for the period from 1981 through 2002, the median Baker Lake reservoir pool level did not exceed 724.8 feet msl until early July. This delayed refill schedule often provided storage for late spring runoff and reduced the frequency of late spring spill. The design of the existing downstream fish passage facility allows the top of the guide nets to be submerged to reduce drag during large spill events to minimize damage to the system. During periods of late spring spill, smolts migrating downstream are attracted to the surface release of water through the spillway and may have passed over the spillway. Under the Proposed Action, refill of Baker Lake must occur by mid-May and must

exceed 724.8 feet msl by May 23. Maintaining a minimum reservoir pool level of 724.8 feet by May 23 provides near full pool conditions for summer recreational benefits, but increases the risk of late spring spill events at Upper Baker dam.

Under the Proposed Action, new downstream fish passage facilities would be designed for both Upper Baker and Lower Baker developments, and the new facilities may be able to operate at some level of spill without damage to the guide nets. It is uncertain whether the passage facility would operate during all spill events. Under the Proposed Action, the generation capacity of the Lower Baker Development would be increased from 4,100 cfs to 5,600 cfs. This increased capacity at the Lower Baker Development would help to reduce the incidence of late spring spill at Lower Baker compared to Current Operations.

**Project Releases**

As discussed in section 3.3.2, Water Quantity, operation of the Baker River Project alters the flow regime in the Lower Baker River and Skagit River downstream of the Baker River confluence. Flow alterations associated with project operations can affect the wetted channel width, alter water quality, and reduce fish spawning and rearing habitat. Project-induced flow fluctuations (project ramping) can also result in the stranding of fish in shallow areas and off-channel habitat (resulting in immediate or delayed mortality); temporary loss of habitat; and the dewatering of fish redds, amphibians, aquatic invertebrates, and plant life (Hunter, 1992). In most cases, the faster the reduction in water surface elevation (stage), and the frequency and magnitude of flow reduction, the greater the likelihood that fish and other aquatic organisms would be stranded or adversely affected. As part of Current Operations, releases from the project to the Lower Baker River are voluntarily regulated. Currently, the voluntary critical flow for ramping is set at 18,000 cfs and downramping cannot exceed 2,000 cfs per hour in the Baker River.

The Proposed Action includes a flow regime measure (Proposed Article 106) that would seasonally set the minimum instream flows downstream of Lower Baker dam ranging from 1,000 cfs in the late summer and fall to 1,200 cfs in the winter, spring, and early summer. Maximum stream flow from the Lower Baker River would also be capped at various levels on a seasonal basis except during flood events. Ramping restrictions ranging from 0 inches per hour during day hours (February 16 – June 15) to 2 inches per hour (day and night hours November 1 – February 15 and night hours February 16 – June 15) would be implemented to meet WDFW interim ramping criteria at Transect 1 on the mainstem Skagit River downstream of the Baker River confluence, but would be measured at the Baker River at Concrete gage based on Baker River and Skagit River discharge relationships. Critical flow for ramping restrictions would be 30,000 cfs at the Skagit River near Concrete gage site. The objective of this measure would be to increase stability of flows in the Lower Baker and Middle Skagit rivers to improve fish habitat,

and reduce fish and aquatic organism stranding and redd dewatering, while providing for recreation, human health and safety, flood control, and hydroelectric power generation.

The flow implementation article would require the installation of two new 750 cfs turbines, which are expected to come on-line within 6 years after the issuance of a new license, at which time the flow regime described above would be fully implemented. During the Interim Operations between when the new license would be issued and the new turbines come on-line, the Baker River Project flow release strategy would follow the IPP flow strategy, which was analyzed by NMFS in their October 25, 2004 biological opinion (NMFS, 2004a), and was found not to jeopardize the continued existence of Puget Sound Chinook salmon. In addition to the IPP flow strategy, maximum flow caps would be implemented to reduce redd dewatering and best efforts would be made to further reduce down-ramping. The interim operations flow plan is presented and analyzed in more detail with regard to ESA listed fish species in section 3.3.6. In general, Interim Operations would provide increased aquatic resource protection over Current Operations by minimizing down-ramping events as much as possible and reducing spawning flows in the Skagit River to minimize salmon redd dewatering during the egg incubation period.

The following effects analysis assumes the full implementation of the flow regime contained in Proposed Article 106, Flow Implementation (using Aquatics Table 1). The effect of flow changes on aquatic habitat can be evaluated by studying fish habitat requirements and estimating the changes in habitat at various flows using hydraulic models. Current Operations and the Proposed Action were analyzed using HYDROPS and post-processing habitat models to estimate habitat effects in the Skagit River downstream of the Baker River confluence.

Following are summaries of modeled effects of flow alterations and fluctuations in the Skagit River downstream of the Baker River confluence. Of note is that flow fluctuations and alterations in the Skagit River are a function of the combined effect of natural flow fluctuations, Skagit River Project operations (FERC No. 553), and Baker River Project operations.

**Flow Alterations**—Flow alterations are changes in river flow over long periods (weeks or months) resulting from the storage of water, water diversion, or reduction of flows due to water conveyance from a dam to a powerhouse. Flow alterations in this EA refers to major changes in the unregulated yearly hydrograph, such as reduction of the total quantity of water delivered to the stream channel through water diversion, or changes in flow derived from seasonal storage for hydropower production. The following is a summary of flow alterations regarding the Baker River Project from R2 (2004d) unless otherwise noted.

Seasonal storage of water at the Baker River Project has resulted in flow alterations of the Lower Baker River and Skagit River downstream of the Baker River confluence. Although the mean annual discharge for the Baker and Skagit rivers is essentially the same when comparing regulated with unregulated conditions (without the Baker River Project), the Baker River Project alters seasonal runoff components, particularly in the fall, winter, and spring. In general, evacuation of the reservoir storage during late August through mid-November results in higher average daily flows in the Baker and Skagit rivers compared with unregulated conditions. Flood control operations result in capture and gradual release of flood flows, which decreases the magnitude of peak flows, but the duration of the event is increased. Reservoir refill reduces flows in the Baker and Skagit rivers from April through June as compared with unregulated conditions. Once the reservoir reaches full pool in July, outflows are generally similar to inflows and are therefore similar to unregulated conditions.

Although current operation of the Baker River Project alters seasonal runoff patterns, mean daily flows for each month remain within the unregulated range of variability throughout most of the year, except during May when refill regularly reduces daily flows in the Baker River to the extent that the average daily flow is less than the unregulated range of variability. In addition, the range of flows under regulated conditions is shifted downward (i.e., the magnitude of change between high and low flows may be similar to unregulated conditions, but high and low flows are less as compared with unregulated conditions throughout the spring and early summer).

*Effects Analysis*

Section 3.3.2.2 describes flow alterations for Current Operations and the Proposed Action. Minimum flows in the Lower Baker River would increase from approximately 80 cfs to 1,000 to 1,200 cfs depending on the month under the Proposed Action. Minimum flows in the Skagit River would increase only slightly throughout most of the year, because resultant changes would be small in comparison with overall flow levels in the Skagit River.

In the absence of the Proposed Action (expanded generation and instream flow regime), the existing reservoir storage operations at the Baker River Project may slightly benefit Chinook egg-to migrant survival by reducing Skagit River peak flows based on general Skagit River basin fish survival relationships (Seiler et al., 2002). However, these peak flow offset benefits were not developed as discrete relationships for the Baker River Project or downstream of the Baker River Project and might need to be verified independently. Nevertheless, for the IPP and until the Proposed Action is in place, interim operating conditions were predicated on this assumed benefit.

Under Current Operations, the Baker River Project is estimated to reduce the Skagit River average annual 3-day maximum flow (downstream of the Baker River

confluence) by approximately 3 percent compared with unregulated conditions (i.e., without the Skagit and Baker River project's influence). Reducing the peak flow from 80,000 to 77,600 cfs (3 percent reduction) would increase egg-to-migrant survival. Flood storage and operations stipulated in the Corps flood control agreement would remain unchanged under the Proposed Action unless and until approved by Corps. The Proposed Action would continue to provide a minor benefit to Chinook salmon egg-to-migrant survival in the Middle Skagit River.

**Flow Fluctuations (Ramping)—**Project-induced flow fluctuations (ramping) can result in unnaturally rapid changes in the flow over periods of minutes, hours, or days. Flow fluctuations can be measured either by change in flow or by change in stage over a specific time interval. Both measures are needed to understand effects associated with flow fluctuations; however, the biological effects of flow fluctuations are most directly related to changes in stage (water surface elevation). Hunter (1992) provides a good description of the potential flow fluctuation effects on aquatic habitats and fish species.

Flow fluctuations can cause direct mortality of aquatic organisms or have indirect and delayed biological effects. Negative effects are generally thought to be most severe during downramping (flow reduction); therefore, downramping is the focus of this effects analysis.

*Effects Analysis*

The number of ramping events and exceedance of the WDFW interim ramping criteria are summarized below for Current Operations and the Proposed Action. The post-processing hourly habitat model was used to determine the total number of downramping events for each energy year and each operational scenario, in excess of Washington State guidelines, at each of the 23 transect locations in the Middle Skagit River. When the flow in the Skagit River at the USGS gage near Concrete exceeded the critical flow of 30,000 cfs, downramping events were ignored at all transects. Generally, more events occurred towards the upstream end of the study reach and fewer events occurred towards the downstream end of the study reach, as would be expected with flow attenuation. A transect-weighted, reach-averaged number of downramping events was determined for the Middle Skagit River study reach by applying transect-weighting factors to the 23 transects. Project operations under the Proposed Action would continue to result in ramping, but total number of ramping events that exceed WDFW interim criteria[24] would generally be less than Current Operations for all months except June and February when there would be no difference between the alternatives (figure 3-16).

[24] 1-inch per hour day and night (June 16 – October 31); 2-inches per hour and night (November 1 – February 15); 0-inches per hour during the day and 2-inches per hour during the night (February 16 – June 15).

The number of ramping events that exceed 2 inches per hour would be reduced in all months. In addition, the number of ramping events that exceed 4 inches per hour would be dramatically reduced or eliminated for all months, except June when the number of events would be increased somewhat. Daytime ramping during winter and spring, which poses a great stranding risk to salmonid fry, would also be discontinued under the Proposed Action. The overall general trend is that the total number of ramping events would be reduced; ramping events during the critical salmonid fry emergence period in the Skagit River from December through July would be reduced; and large ramping events over 4 inches per hour would be greatly reduced under the Proposed Action compared to Current Operations. Reduced ramping rates and eliminating day-time ramping in the winter under the Proposed Action would reduce juvenile fish stranding over Current Operations.

The Proposed Action identifies 30,000 cfs (measured at the Skagit River gage near Concrete) as the critical flow; ramping restrictions would take effect at flows less than or equal to this discharge to minimize fish stranding potential. The Current Operations critical flow is 18,000 cfs. Data gathered at 23 cross-sections representing multiple habitat types in the Middle Skagit River suggest that increased protection would be available at a higher critical flow measured at the Skagit River near Concrete gage. The cross-section data show that flows over approximately 26,000 cfs cover shallow gravels bars, and substantially wet the active river channel of the Skagit River downstream of the Baker River confluence. The critical flow for ramping should occur at flows where most low gradient gravel bars remain continually wetted in order to reduce stranding potential. The critical flow should also occur at flows where the majority of the substrate is wetted, or where the asymptote (i.e., where the curve levels off) occurs for a wetted surface area to discharge relationship. Based on the "wetted surface area to Middle Skagit River flow" relationship, a critical flow of 30,000 cfs would provide over 85 percent of all available substrate in the active channel of the Middle Skagit River, while 18,000 cfs only covers approximately 75 percent of the substrate in the active channel.

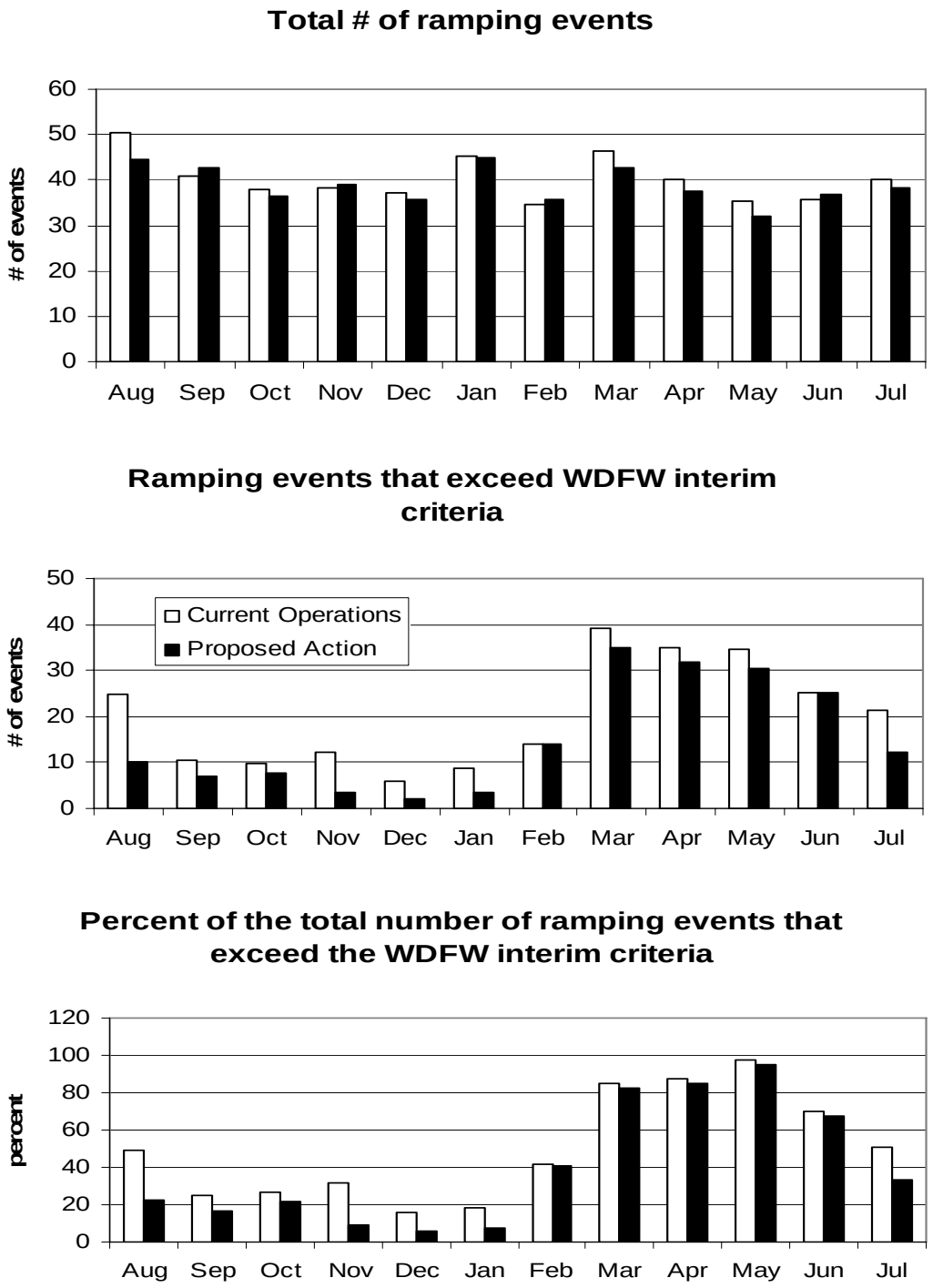



Figure 3-16. Five-year weighted average monthly number of transect-weighted, reach-averaged, downramping events in Middle Skagit River and exceedance of WDFW criteria.

**Redd Dewatering**—The general life history of Pacific salmon involves adult migration into rivers to bury eggs in gravel nests called "redds." The eggs incubate in the gravel environment for several months before emerging as fry at various times of the year, generally from late winter through summer, depending on the species. During the incubation period, the eggs may be susceptible to dewatering during flow fluctuations that may be caused or exacerbated by hydropower project operations, although dewatering caused by natural hydrograph fluctuations also occurs. Redds constructed on the river margin are most susceptible to the effects of dewatering. Redds constructed near the center of the river channel are protected from low-flow dewatering, but are more susceptible to scour during high-flow conditions. Research has documented the lethal effect of redd dewatering on salmonid eggs and alevins. However, redds may be able to tolerate some degree of flow fluctuation, as salmonid eggs and alevins can survive under some situations in subsurface, inter-gravel flow.

*Effects Analysis*

Many salmonids of various species are known to use the 32 miles of mainstem Skagit River below the Baker River confluence for spawning. These species include Chinook, pink, chum salmon and steelhead (R2, 2003f). During aerial surveys conducted as part of Baker River Project relicensing studies, the peak count of Chinook spawning during the fall of 2002 in the Middle Skagit reach was 704 redds (R2, 2003f). The peak redd counts reported by R2 biologists were not intended to quantify total escapement; those figures are developed by the Fish Co-managers. The peak count of chum spawning was 925 redds for the winter of 2002 in the same reach (R2, 2003f). Because substantial numbers of salmonid spawning takes place downstream of the Baker River Project, there is potential for Baker operations to affect salmonid spawning habitat.

Baker River Project operations contributed to redd dewatering during a very low water year in the Skagit River during the spawning season of 2000, which occurred as a result of combined flow fluctuation effects from operation of the Skagit and Baker River projects and natural low flows. WDFW estimated that 80 percent of the total number of Chinook salmon spawning located downstream of the Baker River Project in the mainstem Skagit River were influenced by the combined operations of the Skagit and Baker River projects, but only production from approximately 16 percent of all Lower Skagit River Chinook spawning was lost due to dewatering (Puget, 2002c). Of note is that most Chinook spawning occurs upstream of the Baker River Project influence.

Independent effects that the Baker or Skagit River projects or natural flow variation may have had on redd dewatering were not determined for the 2000 spawning year, nor was it reasonably possible to estimate based on the data available at the time (Puget, 2002c). However, a relicensing study assessed redd dewatering/flow relationships through HYDROPS post-processing for the 5 representative energy years. An index of effective spawning width accounting for redd dewatering and scour was

developed for Current Operations and the Proposed Action for Chinook, chum, and pink salmon and steelhead. This index gives a relative indication of how these two operations affect the available spawning habitat and how scour and redd dewatering impact spawning habitat. The study showed that scour and redd dewatering effects are important determinants in the amount of effective Chinook spawning habitat in the Middle Skagit River, but that redd-dewatering is less important than scour effects for both operational scenarios.

Under the Proposed Action, the maximum flow cap of 3,200 cfs in the early fall is designed to deter anadromous fish from spawning in Skagit River habitats that would not remain wetted during the incubation period, and therefore, the maximum flow cap was designed to reduce redd dewatering in the Skagit River downstream of the Baker River confluence. The minimum flow requirement of 1,000 cfs was designed to provide enough water for spawning in dry years. This goal is reflected in the post-processing estimates of effective spawning width that show the Proposed Action would generally increase effective Chinook, pink, and chum salmon and steelhead spawning habitat over Current Operations. On average, the Proposed Action would provide an increase of 8, 12, 13, and 5 percent more effective spawning habitat for Chinook, pink, and chum salmon and steelhead, respectively, compared to Current Operations.

The Proposed Action's strategy of reducing redd dewatering potential and ramping rates has recently been shown to increase anadromous fish production in the Upper Skagit River upstream of the Baker River confluence (Connor and Pflug, 2004), which is a 27-mile reach of the Skagit River regulated by the upper Skagit River Project. Connor and Pflug (2004) demonstrated that reducing redd dewatering potential and ramping rates resulted in mean spawner abundance increases. The total number of pink and chum salmon spawners significantly increased within the study area after the flow measures were implemented. These increases were substantially greater than those observed concurrently in other areas of the Skagit River basin not influenced by the Upper Skagit Project and in other northern Puget Sound rivers. The average number of Chinook salmon spawners remained unchanged in the study area after 1981, while substantially declining in other unregulated Skagit River subbasins and most Puget Sound rivers. The analysis presented by Connor and Pflug (2004) adds further assurance that reducing redd dewatering potential and ramping rates would benefit anadromous fish production in the Skagit River downstream of the Baker River confluence.

**Spawning Interference**—Bauersfeld (1978) reported that repeated dewatering of spawning areas caused Chinook salmon to abandon attempts to spawn and move elsewhere, often to more crowded locations. However, other researchers reported that Chinook salmon successfully spawned in areas that were dewatered several hours a day (Chapman et al., 1986; Stober et al., 1982). Specific studies were not conducted to evaluate spawning interference in the Skagit River as part of the Baker River relicensing

process; however, the following analysis is based on available analyses of habitat conditions and information reported in the literature listed above.

*Effects Analysis*

Salmonids may begin to spawn in a given area and then have to retreat as the area is dewatered. Fish may return if the area is rewetted to continue to spawn. This interference may have negative effects on spawning fish. One would expect spawning interference potential to increase as the area subject to flow fluctuations increases. The area subject to flow fluctuations is termed the "varial zone" for this analysis. HYDROPS post-processing models were used to calculate the varial zone at the 23 transects in the Middle Skagit River for three time series definitions of the upper and lower extent of the varial zone (figure 3-17).

Under the Proposed Action, the 12-hour varial zone (top graph of figure 3-17) would be decreased during 10 of 12 months when compared to Current Operations. The slight reduction in the 12-hour varial zone may reduce potential impacts on spawning salmon in September through December and on steelhead in March through May. Under the Proposed Action, the weekly varial zone (middle graph of figure 3-17) would also be reduced in 10 of 12 months, and it would be reduced substantially during the peak Chinook spawning season from September through November and the steelhead spawning season from March through May, which may also reduce potential spawning impacts on anadromous fish species. However, a slight increase in the weekly varial zone in December may affect the end of the chum spawning season. The other varial zone time series presented in figure 3-17 (i.e., monthly varial zone) has less influence on spawning interference, but more influence on aquatic invertebrate colonization and production, which is discussed under the Aquatic Invertebrates subsection.

If an increase in the 12-hour and weekly varial zone during peak spawn timing increases the potential for spawning interference, then the Proposed Action would decrease spawning interference potential for Chinook and pink salmon and steelhead trout compared to Current Operations. The Proposed Action may also result in an overall decrease in spawning interference for chum salmon because the varial zone would be reduced during the majority of the peak chum spawning period.

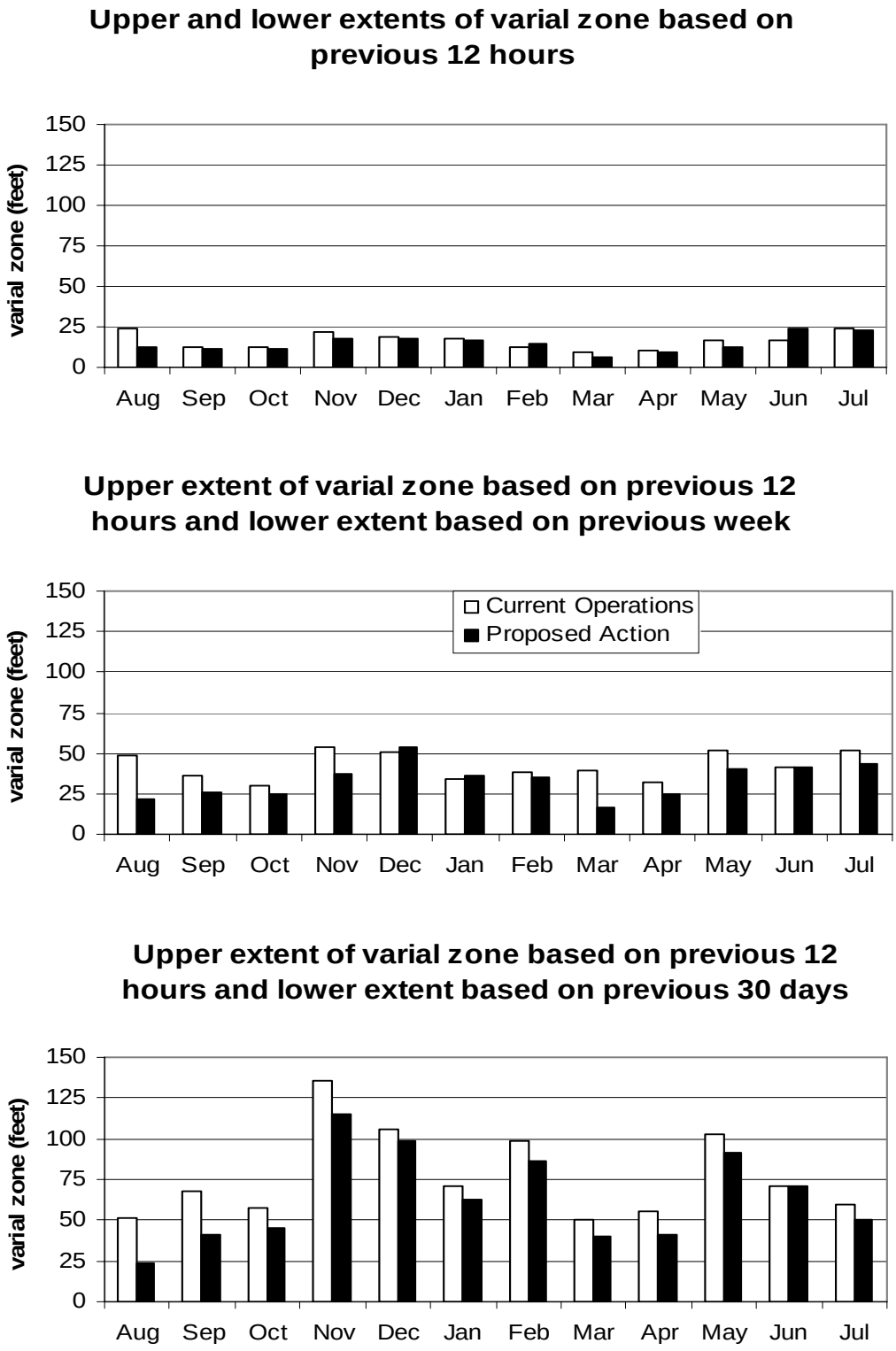



Figure 3-17. Transect- and year-weighted average varial zone width (feet) in the Middle Skagit River.

**Fish Habitat Availability**—Riverine community structure is strongly influenced by habitat stability and availability (Bain et al., 1988). Changes in aquatic habitat stability and availability affect an individual organism's ability to find and use its optimal habitat.

Hydropower peaking can decrease habitat stability and can change the quantity and quality of available habitat over short-time intervals. A study by Pert and Erman (1994) examined rainbow trout habitat use and preference under daily fluctuations in discharge from a hydropower peaking operation. They found that rainbow trout used different habitats under fluctuating flows; however, not all individuals within the population responded similarly to changing stream flow. For adult rainbow trout, mean water column velocity and focal point velocity in the habitat used increased with each successive increase in discharge (Pert and Erman, 1994). The increase in use of higher velocity water may negatively influence the fish's energy budget and reduce energetic efficiency (Fausch, 1984; Jenkins, 1969; Everest and Chapman, 1972).

*Effects Analysis*

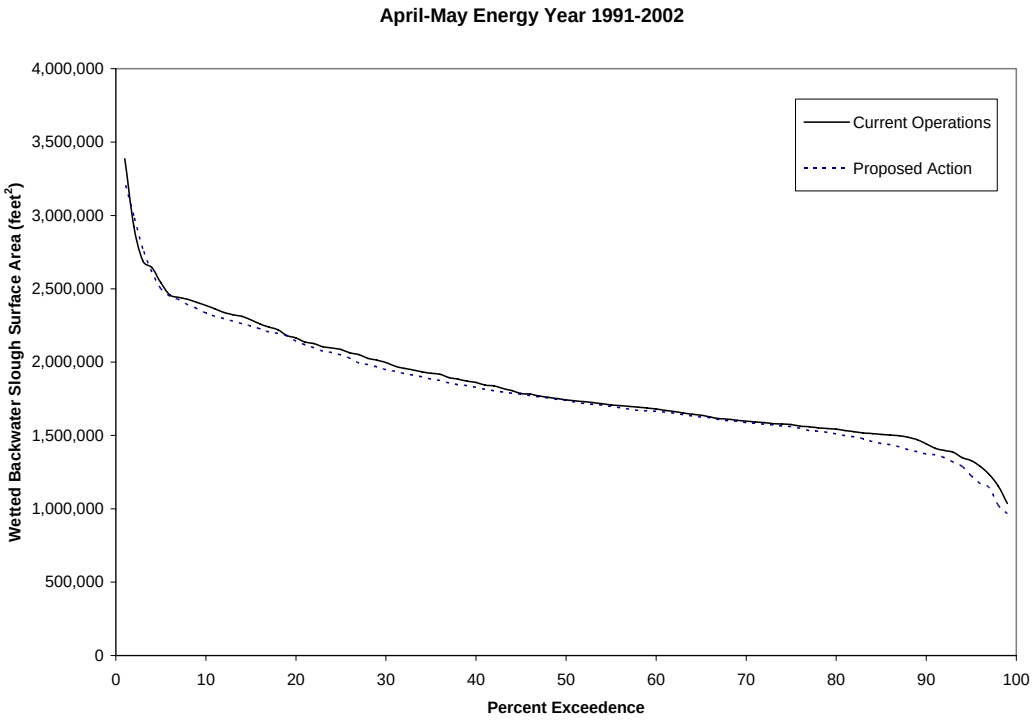
The relicensing study Skagit River Flow and Habitat Assessment estimated the quantity of various habitat types in the Middle Skagit River including spawning, side channel, and backwater slough habitat. Section 3.3.4.1 presents WUA estimates for salmonid spawning habitat (figure 3-14), and Chinook and steelhead trout rearing habitat (figure 3-15). WUA information was used to generate daily backwater slough and sidechannel habitat values for each energy year for Current Operations and the Proposed Action based on average daily flows. Backwater slough and sidechannel habitats are both important rearing habitat for juvenile salmonids during all flows. Backwater and side channel habitats are also very important as refuge habitat from high flows in the spring for salmonid juveniles. Although backwater slough and side channel habitats are both important for rearing and high flow refuge, backwater sloughs may be of greater importance for high flow refuge and rearing in the spring, while side channels maybe more important for rearing during summer low flow periods.

Spring high flows occur primarily in April and May and low summer flows occur in August and September in the Middle Skagit River based on information presented in section 3.3.2, Water Quantity. The WUA information generated for each energy year by habitat type is extensive. In order to summarize this information and to present the data that are important for salmonid species, we present backwater slough and side channel habitat percent exceedance for the spring high flow and summer low flow period.

Figure 3-18 shows that, on an average daily basis, the Proposed Action provides slightly less backwater slough habitat during the spring high-flow period and less backwater slough habitat during the summer low-flow period compared to Current Operations. However, the minimum backwater slough habitat available under the

Proposed Action would be greater (i.e., 100 percent exceedance is greater) during the lowest flows. Figure 3-19 shows that the Proposed Action provides slightly less side channel habitat during high and low flow periods compared to Current Operations. These data indicate that overall the Proposed Action would generally provide slightly less refuge habitat during high flows and less rearing habitat during low flows compared to Current Operations. Of note is that by August and September (low flow period) Chinook, pink, and chum salmon will have already largely migrated out of the freshwater environment to marine waters. In addition, bull trout would not be present in the Middle Skagit River during low summer flows because of high water temperatures. However, other salmonids such as cutthroat, steelhead, and coho juveniles would be present in the Middle Skagit River. All of these species would be present during the high-flow period.

Even though the Proposed Action may provide less backwater slough and side channel habitat compared to Current Operations on an average daily basis, these habitats would be more stable (i.e., more continuously wetted) under the Proposed Action when compared to Current Operations due to the implementation of ramping restrictions, increased minimum flows, and generation caps. Under Current Operations, side channels may be wetted and then dewatered rapidly during a single day due to peaking operations. The amount of backwater slough and side channel habitat was calculated using average daily flow values.



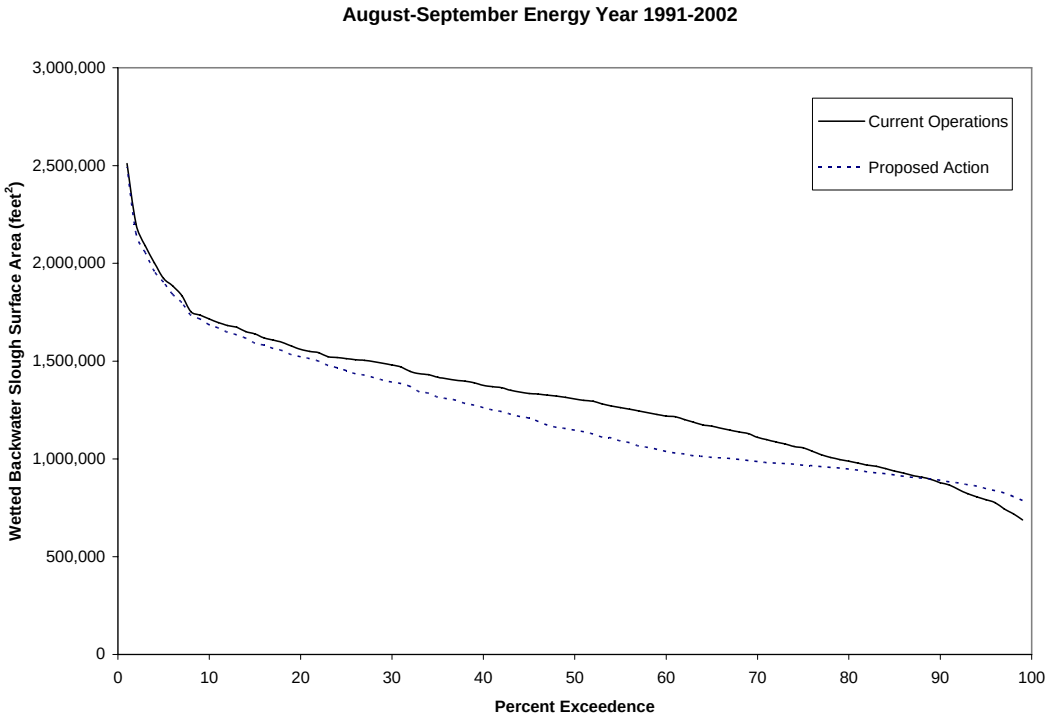
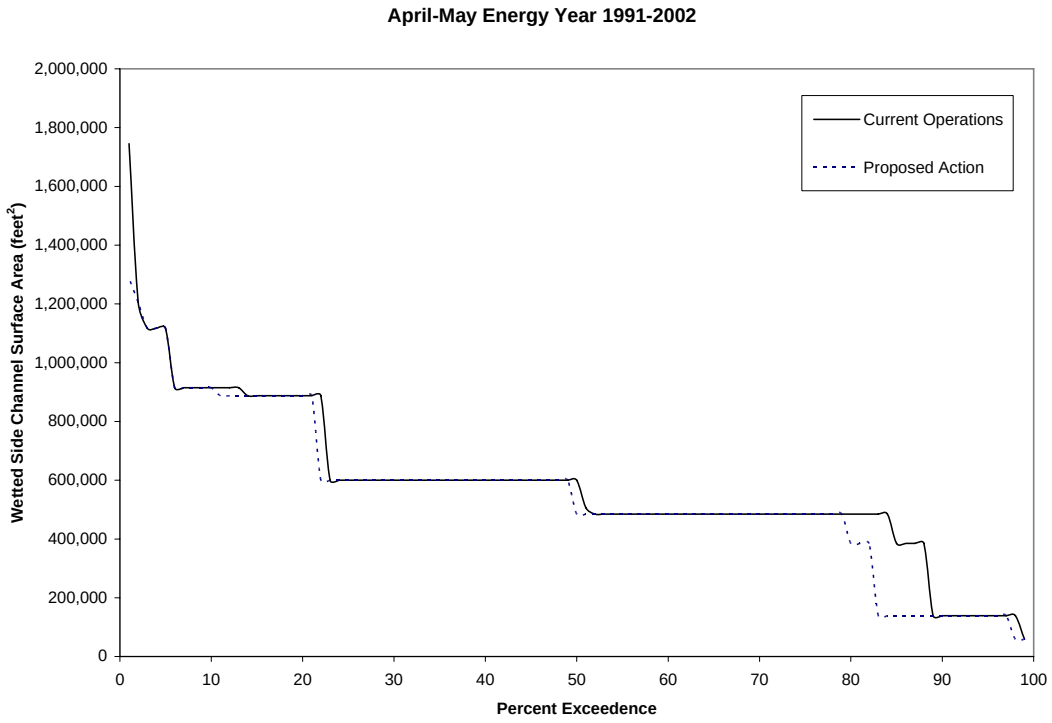




Figure 3-18. Backwater slough surface area in the Middle Skagit River during low- and high-flow months for 12 consecutive energy years (1991–2002).



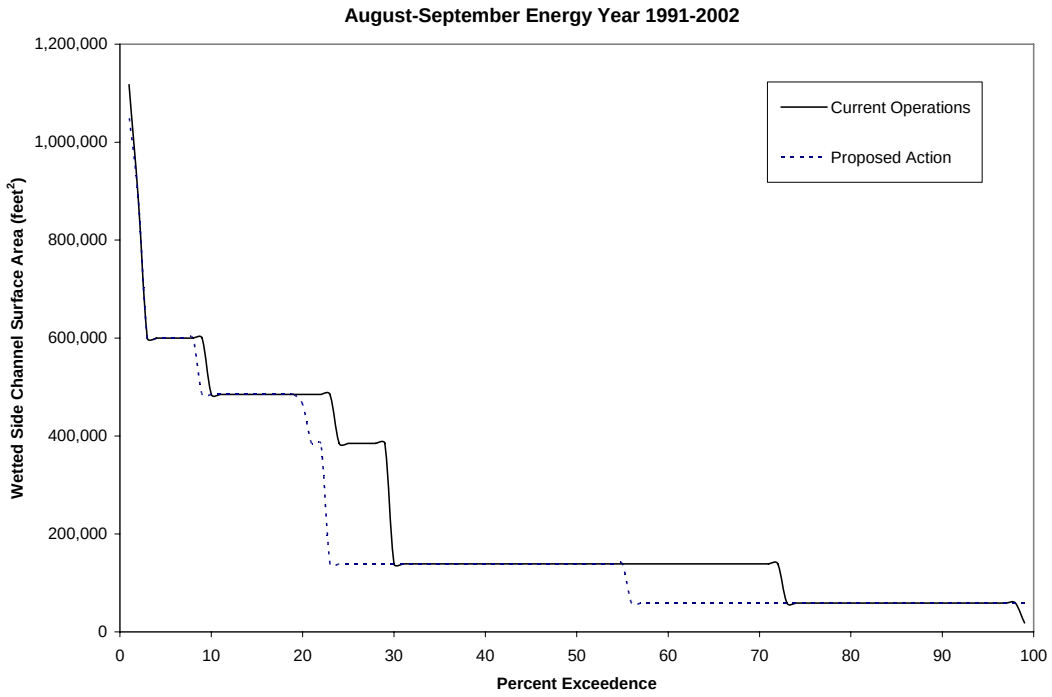




Figure 3-19. Side channel surface area in the Middle Skagit River during low- and high-flow months for 12 consecutive energy years (1991–2002).

Under the Proposed Action, the average daily flow value may be lower than under Current Operations, but there is less within-day stage fluctuation as reflected in the greater varial zone under Current Operations. Channel wetting and dewatering decreases the functionality of these habitats, and fish and aquatic invertebrates would be subject to negative effects, such as stranding.

Current Operations may provide more side-channel and backwater slough habitat when measured on an average daily basis, but under the Proposed Action these habitats would be more stable, which is reflected in the varial zone analysis presented previously (figure 3-17). More stable habitat under the Proposed Action would decrease negative effects such as stranding, and increase side-channel and backwater slough functionality for aquatic species when compared to Current Operations.

**Fish Migration**—Flow fluctuations have been shown experimentally to influence juvenile Chinook to emigrate downstream (McPhee and Brusven, 1976). Extreme low summer flows could also hinder adult upstream migration if water depths are too shallow.

*Effects Analysis*

The varial zone and ramping modeled data can be used to assess the size of the zone subject to flow fluctuations and the number of fluctuations during the juvenile anadromous salmonid residency period. Although juvenile salmonids are present in the Middle Skagit River year round, the majority are present in the winter as they emerge from spawning gravels until outmigration in the spring for most species.

Under Current Operations there is no evidence of significant impairment of adult salmonid upstream migration associated with Baker River Project flow releases. However, varial zone and ramping estimates have been made (see the Spawning Interference under the Ramping analyses). Smaller flow fluctuations would tend to have less influence on fish migrations. The Proposed Action would generally reduce 12-hour and weekly flow fluctuations during the winter and spring compared to Current Operations (figure 3-17). As described in the ramping analysis, the number of large ramping events (rapid flow decreases) over 4 inches per hour would be greatly reduced during the spring under the Proposed Action compared to Current Operations. Therefore, a reduction in juvenile salmonid migration interference may occur under the Proposed Action compared to Current Operations.

Adult salmonid upstream migration would benefit from greater flow provided under the Proposed Action compared to Current Operations; minimum flows would increase over ten fold in the Lower Baker River under the Proposed Action (from 80 cfs to greater than 1,000 cfs). Increased minimum flows in the Lower Baker River would provide greater depth for upstream migrating salmonids to negotiate riffles and would also provide increased cover and holding areas compared to Current Operations.

**Aquatic Invertebrates**—Flow fluctuations have been shown to reduce benthic macroinvertebrate diversity and total biomass and can change species composition. A study on the Skagit River, conducted as part of relicensing of the upstream Skagit River Project (FERC No. 553), found that flow fluctuations had a greater adverse effect on the aquatic invertebrate community than a substantial reduction in average flow (Gislason, 1985). A reduction in the aquatic invertebrate forage base can negatively affect fish production potential. Flow fluctuations can affect aquatic invertebrates through stranding (similar to fish stranding), increase drift response, and may reduce aquatic invertebrate forage.

The composition of the benthic macroinvertebrate community is influenced by many factors including temperature, flow, DO, nutrients, and the structure of the habitat. Flow and water temperature have been found to be the most important factors controlling benthic fauna in unpolluted streams and rivers (Ward and Stanford, 1979). Reduced flow in stream channels results in lower current velocity and reduced wetted area, which can alter composition of benthic fauna and reduce production (Brusven, 1984; Trotzky and Gregory, 1974).

The life cycles of benthic macroinvertebrates are closely linked with the temperature regimes of the streams they inhabit (Lehmkuhl, 1972; Ward and Stanford, 1979; Petts, 1984; Erman, 1996). Water temperature affects the growth rates and fecundity of benthic fauna and acts as a cue for egg development, hatching, and emergence of adults. Alterations of the normal seasonal changes in water temperatures can disrupt the timing of these events to varying degrees (Ward and Stanford, 1979; Erman, 1996). Factors which affect the temperature regime of streams downstream of dams include release depth from the reservoir, thermal stratification pattern of the reservoir, retention time and dam operation (Ward and Stanford, 1979).

*Effects Analysis*

It is anticipated that increasing the minimum flow release from 80 cfs to 1,000 to 1,200 cfs depending on the month under the Proposed Action would increase aquatic invertebrate habitat and production in the Lower Baker River. In addition, under the Proposed Action, ramping events would be reduced, and the 12-hour, weekly, and monthly varial zone would be reduced compared to Current Operations. Therefore, the Proposed Action would increase macroinvertebrate production in the Lower Baker and Middle Skagit rivers compared to Current Operations providing an increase in the forage base for fish.

**Upstream Fish Migration**

The project interrupts connectivity of migrating fish species to upstream locations. Upstream fish passage has been provided at the project since Lower Baker dam was

completed. The current trap-and-haul system has been in operation since 1957 and functions year-round, except for brief periods of maintenance and repair.

The Fish Passage Technical Working Group (FPTWG), created for the Baker River relicensing efforts and composed of experts in the field of fish passage from federal and state fisheries agencies and private companies, was convened to evaluate fish passage alternatives, including volitional and assisted facilities and programs. The FPTWG agreed on a proposed facility concept for Lower Baker for upstream migration using a trap-and-haul concept similar to existing programs but requiring modification to existing facilities.

Under Proposed Article 103, Upstream Fish Passage Implementation, Puget would provide safe and effective upstream passage at the Baker River Project by using trapping, sorting, holding, and hauling facilities located on the Baker River and other operations and facilities as appropriate. Modifications and upgrades to the existing upstream passage facilities or operations would be made in consultation with the ARG and approved by the NMFS and FWS. The upstream passage facility upgrades would be completed within 3 years from the issuance of a new license. In addition, Puget would provide for limited beneficial modifications beyond the scope of any modifications required to meet performance standards. Additional beneficial modifications would be made in consultation with the ARG and approved by NMFS and FWS. Proposed Article 103 would provide for: safe, timely and effective upstream passage of anadromous and resident fish; Access to historical fish habitat above Lower and Upper Baker dams; and The capture, holding, safe handling, sorting, and selection of broodstock.

*Effects Analysis*

After license issuance there would be an interim 2-year period during which the Upstream Fish Passage Implementation Plan and final construction design would be prepared for the new upstream passage facility. During this interim 2-year period, the upstream migration facilities currently in place would be operated in the same fashion as occurs under Current Operations. Handling mortality of upstream migrant fish captured in the trap is estimated to be less than 0.5.

To accomplish the above-mentioned goals, the new upstream fish passage facilities would include fish screens on the gravity intake and a new pump station intake, a fish lock to replace the existing brail and hopper, a sorting facility to provide more automated fish sorting capabilities, post-sorting holding raceways with crowders, a truck loading facility and new access, and a fish sampling facility with a work area.

Puget would provide upgraded fish passage facilities for upstream migratory fish at the Lower Baker Development. This system would be constructed to meet the design

and operation criteria for upstream fish passage facilities developed by the ARG and approved by NMFS and FWS before final Commission approval.

Although final design plans have not been prepared, it is anticipated that by meeting agency design criteria, the new facility would reduce effects on both juvenile and adult fish encountering or entering upstream passage facilities. The new system would include more effective screens on water intakes and fish sorting, holding and transport systems; use water-to-water transfer methods when handling fish; and provide increased or more effective attraction flows to the trap system.

The use of screens that meet agency design criteria on all water intakes should provide protection for juvenile fish encountering the intake system. The proposed trap modifications are expected to further reduce the approximate 0.5 percent or less adult handling mortality observed at the existing facility. Total trap-and-transport time could be approximately 2 hours, which is similar to Current Operations. The new facilities would be sized to capture, process, and transport potential increases in sockeye production that are expected from the implementation of Proposed Article 101, Fish Propagation. Increasing the daily transport capacity would be provided by adding additional tank trucks. Primary benefits of the upgraded fish passage facilities would include reduced handling and stress due to automated sorting features and reduced crowding by creating additional holding ponds. Puget would also allocate up to $20,000 annually for additional upstream passage facility modifications, if needed, as technology advances or monitoring suggest additional modifications are needed. This funding would help assure that the upstream passage facilities keep up with the most recent advances in upstream passage technology during the license term.

**Connectivity Between Baker Lake and Lake Shannon**

Current upstream fish passage facilities at the Baker River Project collect fish below Lower Baker dam and transport them to Baker Lake, bypassing Lake Shannon. There is currently no mode of upstream transport between Lake Shannon and Baker Lake for migratory species, such as native char. Therefore, migratory fish inhabiting Lake Shannon are isolated from the Upper Baker River basin. The FPTWG reviewed a wide range of volitional and assisted passage options. The FPTWG sought to address the need for connectivity associated with populations isolated by Upper Baker dam between Baker Lake and Lake Shannon and made provision for investigation of facilities and/or programs for other species population connectivity needs within the Basin.

To address connectivity between Baker Lake and Lake Shannon, as outlined in Proposed Article 104 of the Proposed Action, Puget would develop a Fish Connectivity Implementation Plan (FCIP) to provide a fishway between Lake Shannon and Baker Lake focused on native char, but including other native fish species that are isolated by the project. No later than 3 years after license issuance, Puget would conduct an

investigation, in consultation with the ARG, to develop and initiate studies with regard to the type of fishway, its location and timing, and the species and numbers of fish to be collected and transported upstream of Upper Baker dam, following approval from NMFS and FWS and final Commission approval.

Fishways provided according to this proposed article may range from, collect-and-haul operations, a temporary weir and trap on Sulphur Creek or a similar facility installed below Upper Baker dam, up to a more permanent trap-and-haul facility below Upper Baker dam. The facility would include design accommodations for other aquatic species that do not compromise the primary design focus on native char and may be lesser in scope and complexity than the adult fish trap downstream of Lower Baker dam. Investigation is necessary to narrow the range of prospective fishway alternatives within this range. If testing demonstrates that the approved prototype fishway does not appropriately achieve fish species connectivity, licensee would propose an alternative plan to the ARG for approval by FWS and NMFS and final Commission approval.

*Effects Analysis*

After license issuance, there would be an interim period (up to 3 years) before the investigation into passage alternatives would occur. Once the passage study was complete, final design would be initiated and a connectivity method would be implemented. Until that time, connectivity would not be provided and existing conditions would be maintained.

To accomplish the above-mentioned goal of providing migration continuity within the Baker River, the new upstream fish passage facilities may be constructed, possibly in lower Sulphur Creek or in the Baker River channel downstream of Upper Baker dam. In-water work, such as installing a concrete sill across the channel for a picket weir attachment point, may be necessary. An access road to the potential trap site would have to be constructed.

Under the Proposed Action, some type of passage connectivity, focused on native char, would be implemented to provide connectivity between bull trout spawning populations located in Baker Lake and Lake Shannon, and to provide for metapopulation linkages for other native fish species.

Bull trout populations are patchily distributed at multiple spatial scales, such as throughout their range, within the Coastal/Puget Sound DPS, and at the local level of the Skagit River basin. This patchy distribution even occurs in watersheds with pristine wilderness characteristics (Rieman and McIntyre, 1995). It is thought that groups of patchily distributed local populations of bull trout may function as a metapopulation of some form at the core area level or local level. In general, a true metapopulation is a collection of relatively isolated, spatially distributed, local populations bound together by

the potential for dispersal between populations to the extent that if one local population was extirpated, the habitat could potentially be recolonized by dispersal of individuals from another local population. A less rigorous definition of a metapopulation requires that the extent of dispersal between local populations only be enough to sustain some level of genetic interaction over time (Whitesel et al., 2004).

Currently, there may be one-way interactions between spawning populations of bull trout within the Baker River basin. Based on recent studies, bull trout have been observed passing from Baker Lake to Lake Shannon. Bull trout spawning in Baker Lake may be contributing to bull trout recruitment in Lake Shannon. This connection may only occur in the downstream direction. Bull trout from Lake Shannon have been observed passing downstream into the Skagit River, but it has not been confirmed that those fish return to the Lower Baker River trap where they may be passed upstream into Baker Lake. The genetic relationship between spawning populations from Baker Lake and Lake Shannon is currently unknown, although tissue samples from adult fish from the various subbasins have been collected. There is a possibility that spawners from Lake Shannon and Baker Lake tributaries may be genetically distinct from one another, or that spawning populations within Baker Lake may be distinct from one another (i.e., Upper Baker River and Park Creek).

Guidelines for effective population size that would be required to sustain bull trout in the Baker River basin through time are important considerations of bull trout population dynamics and connectivity. The number of spawners per year is a good measure of the effective population size (Whitesel et al., 2004). Generally, it is recommended that a spawning population (Ne) should exceed 50 to avoid inbreeding depression and that the population should exceed 500 to avoid the loss of genetic and phenotypic variation through drift (Whitesel et al., 2004).

In the Baker River basin, bull trout produced in Baker Lake tributaries may contribute to individuals found downstream in Lake Shannon (supported by tagging observations). Based on the limited spawning ground surveys, the Upper Baker River spawning population appears to exceed the Ne greater than 50 criteria; therefore, inbreeding depression and short-term genetic viability are not a concern if the Upper Baker River is composed of only one genetically distinct spawning population. However, information about other Baker Lake tributaries and Lake Shannon tributaries are not yet available.

Establishing connectivity between isolated spawning populations has been a fundamental goal in development of all of the draft bull trout recovery plans throughout the bull trout range, except in specific cases in which increasing connectivity between bull trout populations would carry an unacceptable risk of increasing negative interactions and hybridization with exotic fish species such as brook trout. Under the Proposed Action, providing upstream and downstream passage continuity between Baker

Lake and Lake Shannon bull trout populations would allow for two-way genetic exchange between local spawning populations, which would decrease inbreeding depression risk. However, inbreeding depression risk may increase if a trap were to be placed on Sulphur Creek and an excessive number of spawners were captured and moved upstream to Baker Lake, decreasing the Sulphur Creek effective population size. This would be a concern only if Baker Lake and Lake Shannon bull trout are genetically distinct, which is unknown at this time.

It is assumed that through the investigation of connectivity issues, fisheries managers would use the best available science to evaluate passage measures to provide for population connectivity while maintaining an appropriate minimum effective population size and minimizing potential inbreeding depression of local spawning populations in the Baker River basin. Therefore, establishing connectivity under the Proposed Action would benefit native char and other native species in the Baker River basin by reconnecting habitats and populations of fish and providing the opportunity for two-way genetic exchange. Any adverse effects of this action would be minimal and relate primarily to the handling associated with tagging and monitoring of test specimens.

**Downstream Passage Continuity for Migratory Fish Species (Anadromous, Adfluvial, Fluvial, Resident)**

The Baker River Project interrupts connectivity of migrating fish species to downstream locations. The project needs to provide a safe and efficient means of egress to migrating fish. Recent investigations indicate that the existing attraction barge facilities at Upper Baker are an effective means to address fish passage. However, the existing technology is more than 50 years old, and major advances in understanding and technical capability have been developed in the ensuing years. Past evaluations indicate that approximately 50 to 75 percent of juvenile outmigrants are captured and transported downstream. Studies of the collection facility at Lake Shannon suggest that the system in that reservoir is much less effective (approximately 23 percent). Under the Proposed Action, installing new FSCs was selected as the downstream fish passage facility after review of a wide range of volitional and assisted options by the FPTWG.

Under the Proposed Action's Proposed Article 105, Downstream Fish Passage Implementation, Puget would provide safe and effective downstream passage at the Baker River Project by using attraction, guidance, trapping, sorting, holding, and hauling facilities located on Lake Shannon and Baker Lake, and other operations and facilities as appropriate for the Baker River Project. Puget would prepare a downstream fish passage implementation plan (DFPIP) in consultation with the ARG, and approved by NMFS and FWS, within 6 months of license issuance. The plan would be implemented in phases, according to the following schedule in order to sequentially test attraction flow to the FSCs.

No later than 2 years after license issuance, Puget would complete plans and specifications for construction of facilities for attraction, capture, and transport of downstream migrating fish at the Upper Baker and Lower Baker developments. Passage facilities would include a guide net, FSC, transition structure between the guide net and FSC, transportation conduit, floating fish trap, transfer facilities, hauling vehicles, and stress-relief ponds.

Initially, the Upper Baker Phase 1 would include a 500-cfs-capacity FSC (with 1,000 cfs pumping capacity), scheduled to be operational by March 2008. Lower Baker Phase 1 would also include a 500-cfs-capacity FSC (with 1,000 cfs pumping capacity) but would be operational by March 2012. Phase 2 would be initiated at each location if Phase 1 fails to meet performance criteria (developed under the DFPIP) and would include upgrading to an attraction flow of 1,000 cfs at the FSC within 5 years after the completion of Phase 1. If Phase 2 is not implemented at either location due to the success of Phase 1 (at the direction of NMFS and FWS), certain funds would be made available for habitat projects under the Aquatic Riparian Habitat Protection, Restoration and Enhancement Plan. In addition, Puget would allocate certain funds for beneficial modifications beyond the scope of any modifications required to meet performance standards (approved by NMFS and FWS).

*Effects Analysis*

The new Upper Baker FSC is currently scheduled to start up on March 1, 2008, and the Lower Baker FSC is scheduled to start up March 1, 2012. Therefore, there would be an interim 2-year period after a new license before the Upper Baker FSC was complete and operational and an interim 6-year period at Lower Baker. The interim 2-year period is required for final design and fabrication. The interim 6-year period at Lower Baker allows time for final design and fabrication as well as initial testing of the Upper Baker FSC, which may provide valuable information about the design and construction of the Lower Baker FSC to remedy potential problems. This phased approach of installing the new FSC at Upper Baker first, followed by subsequent upgrades at Lower Baker is reasonable and prudent because the majority of anadromous salmonid production occurs in tributaries of Baker Lake.

During the interim period, after license issuance but before the FSCs become operational, downstream passage would be provided at both project dams with existing guide net and FSC systems. Recent investigations of these facilities indicate that under Current Operations between 50 to 75 percent of the marked coho juveniles released into Baker Lake are successfully collected, transported, and released below the project. In contrast, the collection efficiency for coho at the Lake Shannon (Lower Baker FSC) system has been estimated at approximately 23 percent. In the past, less than 2 percent of the marked fish released into Baker Lake has been collected at the Lower Baker FSC on a yearly basis. These data indicate that some upper basin juveniles survive passage through

project reservoirs, turbines, and spill. It is currently unknown what proportion of fish not collected in the Lower Baker FSC pass the project and arrives safely in the Lower Baker River. During the 1950s, researchers identified that sockeye smolts passing over the spillway at Lower Baker dam sustained a survival rate of 46 percent (Hamilton and Andrew, 1954).

To accomplish the above-mentioned goal of providing downstream passage at project dams, new FSC and guide net systems would be fabricated and installed in Baker Lake and Lake Shannon. The FSC units would be fabricated onsite at temporary construction and launch sites along the shores of each reservoir, then floated out and anchored in place. Temporary access would be needed during the construction period. Stress relief ponds would be installed in the vicinity of the upstream trap along the Lower Baker River.

Under the Proposed Action, the new facilities would be designed to increase juvenile survival past the project; however, performance criteria, such as reservoir survival, fish collection efficiency, and trap-and-transport survival are still being prepared through development of the DFPIP in consultation with the ARG, and to be approved by NMFS and the FWS and final Commission approval.

The expected increase in juvenile anadromous salmonid survival and recruitment from the construction of new downstream passage systems cannot be determined at this time because performance criteria have not be identified. Whether more adults would return to the Baker River if downstream passage facilities were improved would be heavily dependent on environmental conditions both within and outside of the project area during the term of any new license issued. External influences, including poor ocean productivity, flood events, intra- and inter-specific competition, and change in harvest rates, affect the number of fish produced from, and returning to, the Baker River. In addition, other outside environmental conditions such as predation, disease, and water quality and habitat degradation in the Lower Skagit River and estuary also influence fish survival and returns to the Baker River.

We conclude that increasing the efficiency of the downstream passage facilities would increase juvenile fish survival. New guide nets would be more effective because the mesh size in the top 30 feet would be decreased from 1/4-inch to 1/8-inch mesh. Increased attraction flow may also increase fish attraction to the FSC. An increase in collection efficiency would reduce fish entrainment (both adults and juveniles) through project turbines and spillways, thereby lessening project effects on both resident and anadromous fish species. In addition, the modernization of these facilities would reduce fish stress and injury from passage through both systems. Well-designed fish passage systems exhibit injury rates less than 0.5 percent (NMFS, 2000b). However, data collected at the Upper Baker FSC show that juvenile mortality rates for collected fish are as good as or better than the 0.5 percent value described by NMFS. These values apply

to both resident fish species such as bull trout, as well as anadromous species such as coho and sockeye.

The proposed stress relief ponds would be designed to reduce fish stress associated with collection, transport and release. It has been shown from studies conducted on the Columbia River that fish plasma cortisol levels become elevated when fish are handled (NMFS, 2000c). This change in fish physiology could cause transported fish to become more susceptible to predation or disease, resulting in decreased survival. The use of stress relief facilities would allow fish to recover, as evidenced by a lower plasma cortisol level, prior to being released into the river. The use of acclimation facilities would benefit fish survival. Facility effectiveness would be evaluated over time by Puget.

An additional benefit of the stress relief facility is that it would allow Puget biologists the ability to measure short-term survival rates for transported fish. Operators would be able to quickly detect problems with the collection and transport system, and make changes as appropriate before impacts to fish survival become excessive. Puget would also allocate certain funds for additional passage facility modifications, if needed, as technology advances or monitoring suggest additional modifications are needed. Providing a long-term passage facility upgrade fund would ensure that the downstream passage facilities remain functional to the greatest extent possible as fish passage technology advances over the term of any new license issued.

**Physical Habitat**

**Fluvial Geomorphic Management**—Sediment originates on hillslopes and is delivered to stream channels via erosion or mass wasting. Generally, dams form permanent impoundments that interrupt the downstream movement of most sediments as the transported material settles in the deep, low velocity reservoirs behind the dams. Trapping of materials within an impoundment reduces sediment delivered to downstream reaches and may result in sediment starvation accompanied by bed armoring and incision. Conversely, if downstream sediment inputs are high and flow regulation reduces the magnitude of flood flows, undesirable amounts of sediment may accumulate within the stream channel.

The Baker River has two distinct sections below the Lower Baker dam. Between the Lower Baker dam and the weir at RM 0.6, the river flows through a narrow bedrock controlled canyon that has a high sediment transport potential with an armored layer consisting primarily of boulders and bedrock. The lowermost section of the river is much less confined, has a lower gradient than the canyon reach, is influenced by backwaters from the Skagit River, and has been straightened and dredged. Prior to channelization, the lowermost section consisted of an alluvial fan, where sediments routed through the canyon were deposited and reworked in the lower energy reach environment. There also was a side channel, the Little Baker River, which meandered within the alluvial fan. The

current straight, incised channel has a higher potential to transport sediments and receives less sediments due to deposition above the dams; this has resulted in a coarse armor layer of bed sediments that remain stable even at high flows. Sediments still accumulate in the reach during high flows in the Skagit River, when backwater effects reduce the velocities and sediment transport capacity in the lowermost section of the Baker River.

The Skagit River downstream of the confluence with the Baker River is a very large alluvial river. Large alluvial channels like the Skagit River typically achieve a state of "dynamic equilibrium" where sediment transport capacity and sediment supply are approximately equal over the long term. Because their bed and banks are comprised of material deposited by the river, they are generally very sensitive to changes in sediment yield and flow.

The project under existing conditions disrupts sediment transport and results in an annual reduction of approximately 12,500 tons of gravel and 2,500 to 4,300 tons of cobble delivered to the Skagit River from the Baker River in comparison to modeled unregulated conditions (R2, 2003e). Overall, the total sediment load delivered from the Baker River is reduced by 86 to 88 percent over unregulated conditions (R2, 2003e).

Operation of the Baker and Skagit hydroelectric projects generally affects Skagit River flows by reducing peak flood flows and increasing daily flow fluctuations. Flood storage provided by the projects has reduced the sediment transport capacity of the Middle Skagit River. Recent reassessment of cross-sections and water surface elevations downstream of the Skagit River near Concrete gage suggests that this reach has aggraded over the last several decades (Corps, unpublished data, as cited in R2, 2004a). Surveys of transects located downstream of Sedro-Woolley suggest that the Lower Skagit River has aggraded by 1 to 2 feet since the 1970s. Therefore, although the Baker River Project has substantially reduced the sediment supply from the Baker River, there is no evidence that the in-channel sediment deposits have substantially decreased (R2, 2004a).

Under Proposed Article 108, within two years of license issuance, or on an alternative schedule submitted to and approved by the Commission, Puget would develop and file a Gravel Management Plan for evaluating sediment interruption by the project and identifying any gravel augmentation measures to be implemented by Puget. Puget would develop the Gravel Management Plan in consultation with the ARG. The Gravel Management Plan would focus on improving the geomorphic function of the Lower Baker River alluvial fan and the project-affected downstream reach of the Skagit River. The fan landform is defined as the mainstem river channel and the associated depositional feature located within the Skagit River floodplain. This plan would include, at a minimum:

- A description of intended gravel augmentation that may address location and contribution of gravel/cobble-sized material in the affected reach, condition

and substrate attrition rates in the reach immediately upstream, substrate change rates within the affected reach, and the relationship between substrate sizes and biological needs of salmonids and other aquatic organisms. The amount of gravel augmentation would not exceed 12,500 tons annually, which is the estimated amount of bedload intercepted by the project.

- Procedures for conducting cost-effective monitoring and evaluations of conditions in the Skagit River to determine any need for gravel augmentation and to track long-term trends in substrate profile degradation.
- Implementation guidelines and triggers for gravel/cobble augmentation that may include the condition of the Middle Skagit River absent project influence, fluvial geomorphic changes throughout the term of any new license issued, and/or habitat suitability for salmonids or other aquatic organisms using the Middle Skagit River.

*Effects Analysis*

The Baker River Project cuts off the supply of bedload from the Baker River basin upstream of the Lower Baker dam. R2 (2004a) estimates that the project has reduced sediment supply to the Skagit River by approximately 6.5 percent, although there is no evidence that, as a result, in-channel sediment deposits have substantially decreased in the Skagit River downstream of the Baker River confluence. However, the river substrate may have coarsened as smaller substrates have been removed over time.

By implementing Proposed Article 108, Puget would improve and enhance the geomorphic and biological function of the Lower Baker River alluvial fan. During the relicensing process, Puget consulted stakeholders while evaluating the feasibility of a range of alternative approaches to improve the geomorphic function and aquatic habitats associated with the Lower Baker River alluvial fan (R2, 2004c). Alternatives evaluated in this effort were intended to complement the Little Baker River Side Channel Restoration Project sponsored by the Town of Concrete and being evaluated by the Corps (Corps, 2001). The Corps developed a preliminary restoration plan and is currently assessing the feasibility of several project alternatives. Puget's feasibility analysis (R2, 2004c) was conducted in a phased approach, which included: (1) development and evaluation of preliminary conceptual designs of a range of alternative approaches, (2) conceptual design refinement of selected alternatives and further evaluation of these alternatives, and (3) revisiting the previously selected alternatives and modifying them as appropriate to be consistent with the flow conditions in the Settlement Agreement. This feasibility evaluation would serve as a basis for Puget's development of gravel augmentation measures to be included in the Gravel Management Plan by Puget.

By developing this plan in consultation with the ARG, monitoring streambed conditions in the Middle Skagit River, and augmenting gravel as defined by the Gravel Management Plan, Puget would ensure that improvements to the Lower Baker River

alluvial fan would be done at a level that does not exacerbate aggradation in the Middle Skagit River. Puget would provide a means of regularly reviewing the status of the Middle Skagit River channel's streambed characteristics during the term of any new license issued, and augment gravel as needed.

**Large Woody Debris**—The role of LWD in Pacific Northwest streams is linked to channel processes that benefit fish and the aquatic community (Montgomery et al., 2003). LWD plays an important role in controlling channel morphology, the storage and routing of sediment and organic matter, and the creation of fish habitat (Bisson et al., 1987). The geomorphic potential of the channel to process wood into features that benefit fish is often limited by the quantity and size of wood (Abbe and Montgomery, 1996). LWD creates habitat complexity by forming pools, back eddies, and side channels and by increasing channel meanders and hydraulic complexity (Spence et al., 1996). A diversity of wood sizes creates debris dams and pools, log jams, and bank features that support a range of fish life stages (Montgomery et al., 2003). Trees recruited to the stream can force creation of pools and bars, thereby increasing habitat complexity (Montgomery et al., 2003). Aquatic productivity also has been linked to LWD, because it retains organic matter that macroinvertebrates process and ultimately increases food sources for juvenile salmonids (Bilby and Likens, 1980). Large wood decays and disintegrates in a stream over time and needs replacement from some source.

The downstream movement of LWD in the Baker River system has been impaired by project dams. Prior to hydroelectric development, some LWD would have moved to the Lower Baker and Skagit Rivers during flood events. The potential effects on aquatic productivity, and in particular salmonid production, due to the lack of LWD that was historically delivered from the Baker River system have not been studied.

Under existing conditions, a total of 528 pieces of LWD are delivered to Baker Lake annually and 246 pieces are delivered to Lake Shannon (R2, 2003d). Some LWD does pass the dams during spill events; however, the number of pieces passed during spill events has not been quantified. Under existing conditions, Puget only removes LWD from the project reservoirs when necessary to ensure safe project operations. It is not known whether LWD availability currently is limiting aquatic productivity in either the Lower Baker River or the Middle Skagit River. However, Smith et al. (2003) rated the Lower Skagit River as poor for LWD recruitment, and most of the Lower Skagit tributaries were also rated as poor for LWD recruitment. The downstream transport of LWD from the Baker River Project would benefit downstream habitats. Under Proposed Article 109, within 2 years of license issuance, Puget would develop a LWD Management Plan in consultation with the ARG and TRIG. The LWD Management Plan would provide for the transport of LWD (i.e., wood over 12 inches in diameter and over 8 feet long) from project reservoirs to mutually agreeable stockpile areas in the Baker River basin to be identified in the plan. The plan would identify the following 20-year targets for transport: (1) 2,960 pieces 1 to 2 feet in diameter, (2) 540 pieces 2 to 3 feet in

diameter, and (3) 160 pieces greater than 3 feet in diameter. Puget would fund the cost of collection and transport of LWD related to the plan.

*Effects Analysis*

The project blocks the downstream movement of LWD except during periods of spill. Under Proposed Article 109, Puget would develop a LWD Management Plan to collect and stockpile LWD on mutually agreeable stockpile areas in the Baker River basin.

Collecting and stocking LWD for others to use in various habitat enhancement projects would address project effects to this resource. LWD could be used by others in streams to increase habitat complexity by forming pools, back eddies, and side channels and by increasing channel meanders. This action would benefit fish as discussed above. However, we see no reason why Puget should not stockpile the LWD it collects on project lands since it appears suitable lands exist for this purpose, particularly adjacent to the Upper Baker dam or near Puget's operations center below Lower Baker dam. We discuss the cost of the LWD Management Plan and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

**Fish Propagation and Enhancement**

As part of the existing license for the Baker River Project, Puget has constructed and funded operations of the existing artificial sockeye spawning beaches. In addition, Puget has voluntarily reared other salmonid species for the enhancement of area fisheries resources (refer to section 3.3.4). Artificial production of sockeye and other salmonids has been used to maintain fish runs, although the strategy could also result in unintended effects on native fish populations through competition for food and space, predation, disease outbreaks, genetic alteration, and harvest (Lichatowich and McIntyre, 1987; Hard et al., 1992; Witty et al., 1995; ISG, 1996; Berejikian et al., 1997; Waples, 1999; Flagg and Nash, 1999; Einum and Fleming, 2001; Cuenco et al., 1993; National Research Council, 1996; Reisenbichler and Rubin, 1999; and Leider et al., 1990). Although the interactions between artificially produced and wild fish have been documented in other stream systems, the relative effect on wild fish from artificial production operations and releases, which incorporate new technologies and strategies to reduce interactions with wild populations, is unknown and continues to be a topic of much debate within the fisheries scientific community. In addition, since the majority of the historic sockeye spawning habitat is currently inundated by the Baker Lake reservoir, there is an ongoing need to provide continued artificial sockeye production to sustain this population.

The Proposed Action includes a fish propagation and enhancement measure (Proposed Article 101) wherein Puget would continue operation of the sockeye spawning beach (Spawning Beach 4) and implement facility upgrades; restore and decommission Spawning Beaches 1, 2 and 3; and add additional sockeye broodstock holding and

incubation facilities at the existing Sulphur Creek facility. The overall sockeye production goal is to roughly triple yearly fry outplants to Baker Lake during an 11-year period, while assessing the lake carrying capacity. In addition, funding would be provided to continue artificial propagation of other species up to 20,000 pounds yearly rearing capacity for no more than 3 months. Species for this production program would be identified by the Fish Co-managers, and may include coho, Chinook, and rainbow/steelhead trout supplementation (or similar cost equivalent).

Within 5 years following license issuance, Puget would also make funding available to the Fish Co-managers for the purpose of evaluating, planning, permitting, and implementing a reservoir nutrient enhancement program. All of the actions in Proposed Article 101 would be conducted in consultation with the ARG and Fish Co-managers.

*Effects Analysis*

**Existing Facility Improvements and New Facility Construction**

Installation of permanent concrete walls between each segment of Spawning Beach 4 would minimize the potential for intermixing of water between beach segments to assist in disease management. The isolation of the water supplies for each segment would be an improvement over Current Operations, because it would simplify water distribution for each segment, which is currently from a single pipeline for the entire spawning beach. Separating the water supply would also add flexibility to each individual segment to provide for flow adjustments that could accommodate differing sockeye loading densities in each segment, and assist in disease management.

Improvement of the existing turbidity alarm system would reduce the potential effects of water supply failures or substantial turbidity increases that could result in reduced sockeye production. Separation of the drains from each beach segment would aid in controlling the possible spread of disease from segment to segment. These improvements would decrease the likelihood of sockeye production losses and would especially minimize the potential for losses of an entire brood year's production due to disease or water supply issues.

Studying the water intake and sediment issues and implementing sediment control measures would result in higher quality spawning beds within the artificial spawning beaches by reducing sediment infusion into the system. This may result in increased egg to fry survival.

Artificial incubation and rearing facilities at Sulphur Creek would be modified to support rearing capacity, up to 20,000 pounds instantaneous rearing capacity for no more than 3 months per year, and to produce up to 11 million sockeye fry at the end of Phase 2.

The facilities may include artificial incubation facilities, a hatchery building, ponds, etc.; however, specific facility proposals are not included in Proposed Article 101.

Overall, facility improvements and new facility construction would represent a benefit to the Baker River sockeye stock by reducing impacts on the cultured stock, while increasing production.

**Restore and Decommission Spawning Beaches 1, 2 and 3**

Under the Proposed Action, Spawning Beaches 1, 2 and 3 would be retained on an interim basis while other measures are implemented. To ensure that these beaches function properly, Puget would make necessary modifications (e.g., reduce leakage, modify water supply) as deemed necessary in consultation with the ARG. At such time as the ARG determines these facilities are no longer necessary, decommissioning would be conducted and may include: (1) configuring of the channel to a natural meander and optimize habitat for fish; (2) removing all structures and restoring landscaping; and (3) initiating fish returns to the site with temporary supplementation.

Continued short-term operation of Spawning Beaches 2 and 3 would help to increase overall sockeye production until the ARG determines that the sockeye run size is sufficient, and the resources used to maintain and operate Spawning Beaches 2 and 3 could be redirected elsewhere. Sockeye adults entering the Lower Baker River trap would be distributed between Spawning Beach 4 and the Upper Baker beaches. Restoration of the Channel Creek stream channel following decommissioning of Spawning Beaches 2 and 3 would be a substantial improvement over Current Operations by increasing habitat quantity and quality below the Baker Lake Highway, which has been reported to block access to the upper reaches of Channel Creek (Forest Service, 2002a).

All potential decommissioning activities would be conducted in collaboration with the ARG, and the Forest Service would be the lead agency in permitting the decommissioning activities since the project is under a Forest Service special use permit. If the activities listed above were to occur, the increase in natural spawning habitat would benefit naturally reproducing salmonids and native fish species in the Baker River watershed, and additional natural fish production would benefit the aquatic community as a whole.

**General Propagation**

The drafting and implementation of a formal operations manual for the spawning facilities would be a substantial improvement over existing conditions. There is currently only an informal operations manual for the spawning beach facilities, and protocols are generally determined on an ad-hoc basis by the BRC. A formal operations manual would establish set protocols for specific events, such as emergencies, spills, and disease

outbreaks, and would also facilitate public review of the fish management protocols at this facility.

A formalized audit process would aid in evaluating the success and efficiency of spawning beach operations and provide the type of information needed by the ARG to adaptively manage the propagation facilities. A formal auditing process would be a substantial improvement over the informal reporting on propagation operations to the existing BRC, as is the current practice.

Ongoing propagation funding, other than for sockeye, would be provided under the Proposed Action. However, numbers and species to be reared and released are unknown. Proposed Article 101 provides for funding equivalent to 20,000 pounds instantaneous cultured fish yearly rearing capacity. The measure does not specifically state which species would be propagated under the 20,000-pound yearly rearing capacity; however, the species and programs would be determined by the Fish Co-managers. All propagation activities would occur in consultation with the ARG, which would be made up of all federal and state fish management agencies and local tribes. We have included the following analysis of releasing 20,000 catchable rainbow trout and 15,000 coho smolts. We have also included an analysis of a Chinook and steelhead program at an unspecified level to assess general impacts that may occur if these programs were implemented under the 20,000-pound yearly capacity.

**Coho Salmon**—The 15,000 smolts would be raised at the Sulphur Creek facility and broodstock would be taken from coho adults returning to the Lower Baker River trap. These fish, along with those produced naturally in the basin, are anticipated to produce approximately 4,600 returning coho adults or more. The 4,600 value is the average number of coho adults that have returned to the Baker River since the Upper Baker Development began operation in 1959. The supplementation efforts, along with fish passage improvements, flow regime modifications, and potential riverine habitat improvements should provide for sufficient coho production in the Baker River system to sustain the adult return goals, and to test downstream fish passage facilities.

Supplementation of 15,000 coho smolts should provide adequate smolt production to meet adult return goals, while minimizing the potential for adverse effects associated with hatchery production. The measure is also consistent with the Hatchery Scientific Review Group (HSRG) recommendation for the Baker River, which suggests that artificial production of coho salmon should be kept at a low level.

**Rainbow Trout**—The rearing and release of rainbow trout would be solely for the purpose of sport harvest in Depression Lake. Depression Lake is a good location for a put-and-take hatchery trout fish, because it would minimize the potential for adverse species' interactions between the hatchery rainbow trout and wild fish in Baker Lake; HSRG (2003) recommended stocking hatchery rainbow trout only in Depression Lake for

this reason. The West Pass dike separates Depression Lake from Baker Lake, and there is no surface water connection between the two water bodies. There is a possibility that small numbers of hatchery rainbow trout could be introduced into Baker Lake during pumping operations from Depression Lake or to Lake Shannon via an overflow channel that drains to the reservoir, although the likelihood of such events is low and would not be expected to pose a threat to wild fish production in Baker Lake or Lake Shannon.

**Chinook Salmon**—If Chinook were produced under the 20,000-pound capacity program, these fish would be reared at the Sulphur Creek facility. Prior to rearing, a study would be needed of potential adverse effects and benefits, to determine whether rearing Chinook in the Baker River system or supporting other Skagit River programs would be most beneficial to overall Skagit River spring Chinook production.

A Baker River Chinook program would also be consistent with the HSRG recommendations because it would expand the range of spring Chinook in the Skagit River basin. It is believed that the program would release low numbers of Chinook juveniles; therefore, these potential effects would not be expected to produce a substantial adverse effect on fish populations in the Baker and Skagit rivers.

**Steelhead Trout**—Since 1959, average steelhead returns to the Baker River have been about 230 fish. The Baker River is not currently thought to support a self-sustaining population of steelhead; therefore, the use of hatchery fish in the Baker River system would not compromise existing wild steelhead production in the system. There would be potential for a portion of any hatchery steelhead smolts to residualize and remain in the Baker River system for prolonged periods. Residual steelhead could pose a predation risk to sockeye fry and other salmonid juveniles including Chinook salmon and bull trout (Whitesel et al., 1994; Jonasson et al., 1994, Jonasson et al., 1995, Jonasson et al., 1996, Cannamela, 1993, Beauchamp, 1995). These studies suggest that while there is the potential that some of the artificially produced steelhead smolts may prey upon other juvenile salmonids in the Baker and Skagit rivers, the levels of predation would be low.

### Increase Sockeye Propagation

A primary goal of the Proposed Action is to release a total of 14.5 million sockeye fry to the Baker River watershed following a phased propagation program. The program would incrementally increase fry releases over a total of 11 years. As part of the sequential development, a study would be conducted by the end of year 2 to evaluate the carrying capacity of Baker Lake and Lake Shannon for sockeye fry. In addition, tests would be conducted concurrently with the sequential increases in sockeye fry production in order to empirically test sockeye production limits of the Baker River watershed. Through this sequential increase and testing program in combination with the proposed passage improvements, sockeye adult returns should increase.

Hatchery intervention in the form of artificial spawning beaches has been adequate to maintain the sockeye stock at low but acceptable levels of abundance (HSRG, 2003). In most years since 1990, the program has attained the goal of returning at least 3,000 spawners to the lake system and artificial beaches. The stock has been successfully maintained, with little alteration of its natural life history pattern, since the inception of the program in 1957. Proposed changes in management, by confining spawners to a single artificial spawning beach, would substantially increase the demographic risk to the population from natural events like siltation, flooding, and disease. There is a risk associated with the inability to properly sort returning adults at the Baker River trap. There is also a potential risk associated with the general lack of information on the hydrology, nutrient input, predation and food availability in the receiving waters of Baker Lake. The goals for Baker River sockeye pose little or no threat to other indigenous stocks in the Baker River system and are consistent with the goals for other stocks and species.

The Proposed Action incorporates the HSRG recommendations for the Baker River sockeye program with regard to spawning beach upgrades, upstream and downstream migrant trap upgrades, and studies to assess limnological characteristics of the reservoirs in order to reduce or eliminate the risks that the HSRG has identified.

**Reservoir Nutrient Enhancement**

Reservoir nutrient enhancement funding is also part of Proposed Article 101. Within 5 years of any new license issued, Puget would provide funding to the Fish Co-managers for the purpose of evaluating, planning, permitting, and implementing a reservoir nutrient enhancement program.

According to Mazumder (2004), lake fertilization is not recommended at this time, since it appears that nutrients are not currently limiting sockeye production in the Baker River watershed. However, reservoir fertilization may be beneficial under increased sockeye recruitment compared to existing sockeye production levels. It is not known whether the reservoirs could support more than 14 million fry per year without nutrient enhancement.

The Fish Co-managers could determine whether the use of salmon carcasses or fertilizer would be most suitable for this program. Carcasses have the potential to spread disease, although such effects are reduced when adults native to the system are used (Cederholm et al., 1999).

**Ongoing Resource Monitoring and Management**

Proposed articles 102 and 603 provide for ongoing aquatic resource monitoring, reporting, and adaptive management. All aquatic resource and habitat provisions included in the Proposed Action require ongoing evaluation and decision-making during

the course of the license so that management of resources can adapt to changing conditions in the Baker River system by using adaptive management principles (Article 603). Under Current Operations, Puget voluntarily participates in the BRC, which is responsible for making management decisions pertaining to the aquatic resources of the Baker River system.

Under the Proposed Action, Puget along with parties to the Settlement Agreement would form the Baker River Coordinating Committee (Article 601). The BRCC would have an expanded membership compared with the existing BRC and would deal with a variety of resources, not solely aquatics. The BRCC would manage settlement implementation and resource management issues over the course of the license. Several subcommittees, including the ARG, would be formed to focus on specific resource issues. The ARG would be responsible for studies and monitoring required for implementation of the license and to address any other aquatic resource needs that may arise during the license period.

The BRCC and ARG would implement adaptive management principles. Results of monitoring and studies of fisheries resources would be continually reviewed at least on an annual basis, and the group would determine how resources should be managed in the future, based on the findings and experience of past activities. Generally, the BRCC would only move forward on an issue once consensus on a subject has been reached, thereby avoiding dominance of a single party in resource decisions.

One of the responsibilities of the BRCC would be to oversee Puget's administration of the Habitat Enhancement, Restoration, and Conservation Fund (HERC Fund; see Proposed Article 602) and the ARP (see Proposed Article 505), annual funds to be used for aquatic resources-related activities and riparian habitat protection. The purpose of these funds would be to address potential effects of the Baker River Project and provide for enhancement of aquatic and riparian resources in comparison with existing conditions. Annual funds would allow the BRCC to address ongoing aquatic resource needs over the course of the license.

These funds may be used to address some of the following topic areas, as deemed appropriate by the BRCC: (1) Native non-salmonid species; (2) A native resident salmonid program and recreational fishing opportunities: (3) Non-native and invasive aquatic animal species; (4) Water quality enhancement; (5) Riparian habitat enhancement; (6) Stream channel improvements/modifications; (7) Noxious weed control; (8) Passage facility modifications; (9) Supplementation programs; (10) LWD placement projects independent of the LWD article (Proposed Article 109); and (11) Implementation of aquatic habitat restoration and conservation measures.

Various inspection and monitoring regimes would be implemented to assess the efficiency of trap modifications, water quality, fish propagation success, sediment and

erosion control, etc., as part of many proposed aquatic related articles. Where applicable, monitoring actions were previously evaluated in specific resource sections.

*Effects Analysis*

Establishment of the BRCC would ensure a long-term collaborative approach to aquatic resource management in the Baker River basin. The BRCC would provide for the representation of a variety of interests in aquatic resource management. Creation of the BRCC and the ARG also would help to ensure that all license provisions were fully implemented. The adaptive management principles that would guide the BRCC would provide the management flexibility needed to manage environmental resources, which are in a constant state of flux. Thus, the BRCC would provide a long-term benefit for aquatic resources of the Baker River system by creating a structured, yet adaptive management framework.

The HERC fund would be used for actions that would enhance, conserve and/or restore aquatic species. This fund would also be used to mitigate for unforeseen impacts not otherwise addressed in other proposed license articles. Possible uses of the HERC fund describe by Puget include: resident salmonid programs, native species initiatives, recreational fishing opportunities, controlling non-native or invasive aquatic animal species, water quality enhancements, riparian enhancements, channel modifications, noxious weed control, and modifications to fish passage facilities and supplementation programs in the basin not required by other articles.

Although Puget provides some examples of how HERC funds may be used, Puget does not provide any specific measures to be implemented using these funds. Without specific measures, we cannot evaluate the fund's environmental effects or the fund's nexus to the project. We make our final recommendation regarding the HERC fund and Proposed Article 602 in section 5.1, Comprehensive Development and Recommended Alternative.

Likewise, the ARP (Proposed Article 505) also does not include enough detail to allow us to assess the potential benefits of the specific measures that would be implemented by this plan, or the nexus of these measures to project impacts. We make our final recommendation regarding the ARP and Proposed Article 505 in section 5.1, Comprehensive Development and Recommended Alternative.

#### 3.3.4.3 Unavoidable Adverse Effects

Regardless of the collection efficiency level achieved by the new downstream fish passage systems, some project related mortality would occur to both resident and anadromous fish due to the handling required to collect and transport fish, and the inability to collect fish during extreme flood flows. However, increased collection

efficiency and handling practices would improve overall fish production in the Baker River watershed.

Short-term increases in turbidity and minor water quality impacts are likely to occur associated with the construction of the powerhouse facility, upstream passage facility upgrade, FSCs, passage facility for connectivity, fish propagation facility, and the spawning beach decommissioning. As discussed in the Secondary Effects portion of section 3.3.3, Water Quality, Puget would limit risks of degrading water quality through implementation of a water quality protection plan (Proposed Article 401). This would include adoption of appropriate best management practices for all activities.

#### 3.3.4.4 Cumulative Effects

Skagit River Project operations when combined with current Baker River Project operations produce an adverse cumulative effect on fish habitat availability, redd dewatering, and fish stranding in the Middle Skagit River due to river fluctuations. These effects are described in detail in section 3.3.4.2. The Proposed Action reduces cumulative effects, such as redd dewatering and stranding potential, when compared to Current Operations.

Cumulative effects may arise from the total production and releases of hatchery fish from the Baker River Project to the Skagit River basin. Hatchery fish may stray and spawn with wild fish within the Skagit River basin and may also stray to other basins, although the effects of this are unknown. The Proposed Action is consistent with HSRG (2003) Skagit River and Baker River artificial production recommendations and would represent a positive benefit to local wild fish stocks compared to existing conditions.

Cumulative effects on aquatic habitat could also arise through increased land development and urbanization throughout the Lower Skagit River watershed. Recreational and commercial fish harvest may cumulatively affect fish populations. The project neither controls nor cumulatively affects these activities. Skagit River Watershed restoration planning is currently underway. Watershed restoration activities, in combination with instream flow requirements and ramping restrictions under the Proposed Action, may have a cumulative benefit for aquatic resources in the Skagit River basin; however, specific watershed restoration projects have not been evaluated. No other major land-use or construction projects are known that in combination with project operations may cumulatively adversely affect aquatic resources.

### 3.3.5 Terrestrial Resources

#### 3.3.5.1 Affected Environment

The following sections describe the existing vegetation and wildlife resources in the Baker River Project vicinity, including cover types, distribution of vegetation and

wildlife, and special status species. Information sources include Puget's surveys and study reports, Forest Service data and reports from the Mt. Baker Ranger District, and WDFW data on priority habitats and species.

We provide information about federally threatened and endangered species in section 3.3.6, Federally Listed Threatened and Endangered Species and Essential Fish Habitat.

Past actions from a variety of sources have affected certain key wildlife habitats in the Baker River basin. Key habitats identified through scoping and studies include mature and old-growth coniferous forest, deciduous forest, riparian habitats, and wetlands. In the following section, the description of the existing condition for these key habitats is expanded to include discussion of past actions that have led to the current status of the habitat in an effort to better describe existing conditions.

**Plant Communities and Wildlife Habitats**

The Baker River Project is located within the western hemlock (Tsuga heterophylla) zone of the Northern Cascades Physiographic Province (Franklin and Dyrness, 1988). Mt. Baker (elevation 10,778 feet msl), Mt. Shuksan (elevation 9,127 feet msl), and other high mountain peaks rise up from the Baker River and the project reservoirs on the west, north, and east sides. Along these slopes, vegetation transitions to higher elevation assemblages including the Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*), parkland, and alpine zones. The glaciers and snowfields associated with the high peaks and ridges funnel cold air down into the Baker River basin. This effect is particularly strong on the western side of Baker Lake, where several plant species typical of higher elevations occur at unusually low elevations (Forest Service, 2002a).

Events of both natural and human origin have modified forest stands in the Baker River basin. Natural disturbance events include wind storms, wildfire, and avalanches. Human disturbance of vegetation has occurred through timber management activities, fire, limited residential and recreational development, and the development of the Baker River Project.

The northern portion of the Baker River basin is a mosaic of forest stand ages, containing large tracts of both old-growth and second growth coniferous forest. Most of the area is federally managed as National Forest System and National Park System lands, and timber harvest is currently restricted. The southern portion of the basin supports extensive, ongoing management of private and state timberlands. Little old-growth forest remains, and the area is dominated by second- and third-growth stands of Douglas fir (*Pseudotsuga menziesii*), western hemlock, western redcedar (*Thuja plicata*), red alder (*Alnus rubra*), and other less common species.

Table 3-17 presents the acreages of each major vegetated cover type in the Baker River Project area by reservoir subarea. The project area was mapped through aerial photograph interpretation and ground verification of cover types and polygons. Detailed information about the vegetation mapping of the project area is contained in Hamer Environmental et al. (2004). The project area includes approximately 8,527 acres, including about 2,273 acres of reservoir at Lake Shannon and 4,977 acres of reservoir at Baker Lake (both at near full pool elevations). The cover type mapping was performed when water surface elevations were below full pool and includes acres of emergent grass/forb cover types within both reservoirs (Hamer Environmental et al., 2004).

Table 3-17. Baker River Project area cover types (in acres). (Source: Hamer Environmental et al., 2004)

| Cover Type/Structure Class | Lake Shannon Subarea | Baker Lake Subarea | Total Project Area | Percent of Total |
|---|---|---|---|---|
| **Coniferous Forest** | | | | |
| Old-growth | 26 | 58 | 84 | 4.8 |
| Mature | 44 | 276 | 320 | 18.4 |
| Mid-successional | 1 | 61 | 62 | 3.6 |
| Pole | 0 | 13 | 13 | 0.7 |
| **Mixed Coniferous/Deciduous Forest** | | | | |
| Mid-to-late seral Stage | 111 | 165 | 276 | 15.9 |
| Young seral stage | 0 | 0 | 0 | 0.0 |
| **Deciduous Forest** | | | | |
| Mid-to-late seral stage | 143 | 282 | 425 | 24.5 |
| Young seral stage | 6 | 19 | 25 | 1.4 |
| Shrub | 10 | 34 | 44 | 2.5 |
| **Rock/Talus/Bare Soil** | | | | |
| Rock/talus | 0 | 0 | 0 | 0.0 |
| Cliff | 1 | 2 | 3 | 0.2 |
| Unvegetated upland | 0 | 1 | 1 | 0.1 |
| **Disturbed/Modified Cover Types** | | | | |
| Residential/developed | 20 | 1 | 21 | 1.2 |
| Project facilities | 7 | 64 | 71 | 4.1 |
| Other disturbed | 10 | 9 | 19 | 1.1 |
| **Grass/Forb Cover Types** | | | | |
| Herbaceous species | 82 | 269 | 351 | 20.2 |
| **Roads** | 6 | 16 | 22 | 1.3 |
| **Total** | 385 | 1,001 | 1,386 | 100.0 |

Table 3-18. Baker River basin major cover types (in acres). (Source: R2, 2003j)[a]

| Cover Type/Structure Class | Skagit County Subarea | Whatcom County Subarea | Total Baker River Basin | Percent of Total |
|---|---|---|---|---|
| **Coniferous Forest** | | | | |
| All classes | 27,383 | 79,304 | 106,687 | 56.0 |
| **Deciduous Forest** | | | | |
| All classes | 3,237 | 2,356 | 5,592 | 2.9 |
| **Shrub** | | | | |
| Shrub | 1,906 | 8,165 | 10,072 | 5.3 |
| **Grass/Forb** | | | | |
| Grass/forb/sparse vegetation | 2,539 | 23,666 | 26,205 | 13.8 |
| **Wetlands** | | | | |
| All wetlands[b] | 392 | 1,099 | 1,491 | 0.8 |
| **Rock/Talus/Bare Soil** | | | | |
| Rock/talus/bare soil | 384 | 18,944 | 19,328 | 10.1 |
| **Disturbed/Modified Cover Types** | | | | |
| All types | 61 | 0 | 61 | 0.0 |
| **Water** | | | | |
| Reservoir/lakes/snow/ice | 1,999 | 19,126 | 21,125 | 11.1 |
| **Total** | 37,901 | 152,660 | 190,561 | 100.0 |

[a] The R2 (2003j) estimates of habitat area in the Baker River basin have not been adjusted to reflect the shift to NAVD 88 and may differ from figures used elsewhere in this document.

[b] Above reservoir, including small natural lakes.

The Whatcom County subarea referenced in table 3-18 includes the majority of the Baker Lake basin surrounding Baker Lake; the Skagit County subarea includes the southernmost portion of Baker Lake and all of the lands surrounding Lake Shannon.

### Coniferous and Mixed Coniferous/Deciduous Forest

Coniferous forests capable of exhibiting great biomass and longevity dominate the Baker River basin (Forest Service, 2002a). Old-growth coniferous forests are characterized by very old and large overstory trees. Many additional structural attributes contribute to the high value of old-growth stands for wildlife, including variation in tree size and spacing, broken and deformed tops, multiple canopy layers, canopy openings, variation and patchiness of understory composition, and large-diameter standing dead and

downed trees. This complex habitat supports a large number of plant and animal species, some of which are found only in late seral forests. Mature forests typically exhibit some, but not all, of the components of old-growth forests.

Elevation influences the species composition and biomass of coniferous forests. In the Baker River basin, lower elevation forests in the western hemlock zone are capable of high productivity and very high standing biomass. These forests are dominated by Douglas fir, western hemlock, and western redcedar, including some of the oldest and largest trees on the Mt. Baker-Snoqualmie National Forest (Forest Service, 2002a). The higher elevation silver fir and mountain hemlock zones are less productive than the lower elevation forests because of differences in soil composition and environmental factors. The distribution of late seral stands across the landscape also influences their quality to wildlife. Large stands are better able to support those species that require large contiguous patches of interior forest. Travel corridors between stands are important for some interior forest species that move long distances; corridors provide pathways for dispersal of young and allow access between seasonal habitats, high- and low-elevation ranges, and along riparian zones.

Species closely associated with late seral coniferous forest include the northern spotted owl (*Strix occidentalis* spp. *caurina*), marbled murrelet (*Brachyramphus marmoratus*), pileated woodpecker (*Dryocopus pileatus*), northern goshawk (*Accipiter gentilis*), American marten (*Martes americana*), Johnson's hairstreak butterfly (*Mitoura johnsonii*), certain terrestrial mollusks, and several vascular plants, lichens, and mosses.

Naturally occurring events that have shaped the age and structure of the Baker River basin forests include wildfire, landslides, wind storms, avalanches, and lava flows. Human activities profoundly influenced the age and distribution of forest stands during the past 100 years. The first sawmill in the Middle Skagit River valley was established near Birdsview in 1878, and timber harvest within the Baker River basin was in full swing by 1922 (Puget, 2002b). Timber harvest has occurred on private, state, and National Forest System lands within the basin. Road building and limited residential and industrial development have also influenced the forest stands.

The Lower Baker Development was constructed at a time when logging was actively occurring along the Lower Baker River. Creation of Lake Shannon contributed to timber harvest volumes, providing over 100 million board feet of timber; it also interrupted commercial timber harvest, forcing the relocation of the primary rail line to the east side of the proposed reservoir. The Baker Lake area was largely harvested immediately prior to inundation. However, the filling of the reservoir also served to block access to, and prevent the logging of, National Forest System and private (Scott Paper Company) lands on the east side of the basin, including some being logged near Noisy Creek at the time of inundation. Approximately 4,984 acres of coniferous and mixed coniferous-deciduous forests of varying ages (Biota Pacific et al., 2003) were

harvested or inundated by the project reservoirs. Because commercial timber harvest was a primary land-use activity in the basin, much of this land would have been harvested prior to the early 1990s if the project had not been constructed. Timber harvest slowed dramatically in the basin during the 1990s, as a result of changes in management direction for the protection of spotted owls and other old-growth dependent species.

Private and state timberlands surrounding Lake Shannon are dominated by second- and third-growth coniferous forest, and currently support little or no old-growth forest (Puget, 2002b). The Forest Service estimated that 39 percent of coniferous forested habitats on National Forest System lands in the Baker River watershed are currently in early to mid-seral stages, primarily as a result of timber harvest (Forest Service, 2002a).

Mature and old-growth coniferous forest stands remain primarily in the northern portion of the watershed. The Forest Service estimated that 10,541 acres of mature coniferous forest and 41,735 acres of old-growth coniferous forest remain on National Forest System lands in the watershed (Forest Service, 2002a). This represents 61 percent of all coniferous forest habitats on National Forest System lands. Remaining mature and old-growth forest at low to mid-elevations on the west side of Baker Lake have been highly fragmented due to timber harvest and road building. Fragmentation of mature and old-growth stands has occurred to a lesser extent on the east side of Baker Lake. Currently, about 680 acres of mature and old-growth coniferous and mixed coniferous/deciduous forest are present within the project area. The majority of this acreage (73 percent) is located around Baker Lake. Hamer Environmental et al. (2004) includes detailed habitat information about tree species composition, diameter class, canopy cover, coarse woody debris, and snags for sample sites within these habitats.

Puget owns a limited amount of land surrounding the project reservoirs and does not currently implement specific management measures for late seral forest habitat. The Forest Service has implemented specific management practices to protect late seral coniferous forest and the species that depend on this habitat. The Northwest Forest Plan (Forest Service and BLM, 1994a,b) established a system of late successional reserves (LSRs) to provide habitat capable of supporting viable populations of species associated with late successional and old-growth forest. The Baker LSR is about 82,100 acres and almost completely surrounds Baker Lake. Designated Conservation Area (DCA) WD-21 was established in 1992 for the protection of northern spotted owls under the ESA (FWS, 1992). It encompasses roughly 104,000 acres of National Forest System lands on the Mt. Baker Ranger District, including 29,750 acres not included in the Baker LSR. Commercial timber harvest activity has been at a standstill on the Mt. Baker Ranger District since the early 1990s.

Washington State Forest Practices Rules specify standards for commercial timber harvest on non-federal lands. Included in the Forest Practices Rules are specific requirements for lands supporting listed fish and wildlife species. State and private

timberlands surrounding Lake Shannon are managed under these rules. Additionally, state-owned timberlands in the watershed are managed in accordance with a Habitat Conservation Plan (HCP) prepared by the WDNR under the provisions of section 10 of the ESA. The HCP has a number of management provisions specific to the protection of habitat for late-seral wildlife.

State and private lands surrounding Lake Shannon are expected to be managed for timber resources in the future, resulting in continued rotation of forest stand ages, within the requirements of Washington State Forest Practices Rules and the WDNR HCP. The ongoing management designations on National Forest System lands surrounding Baker Lake, including LSRs, DCA, Riparian Reserves, Wilderness and Recreation reserved areas, and administratively withdrawn lands, are expected to provide protection to old-growth and mature forest values in the future.

**Deciduous Forest and Shrub Habitats**

In the Baker River Project vicinity, deciduous forest stands characterize sites with relatively recent and/or frequent ground disturbance, such as timber harvest, landslides, avalanche chutes, and riparian zones of low to moderate gradient streams and rivers. Red alder is the dominant recolonizer of disturbed soils within the western hemlock zone; it is also common within riparian zones. Big-leaf maple (*Acer macrophyllum*) is common in riparian zones and in openings in coniferous forest. Black cottonwood (*Populus balsamifera spp. trichocarpa*) is the dominant overstory species along riparian zones with moderately to well-developed floodplains. Within areas of frequent disturbance, such as avalanche chutes and riparian zones, deciduous shrub communities may persist; these are typically dominated by willows (*Salix species*), vine maple (*Acer circinatum*), and salmonberry (*Rubus spectabilis*).

Deciduous forest stands along riparian zones can provide locally unique wildlife habitat when certain structural features are present. Locally unique features can include variation and patchiness of understory vegetation, snags and downed logs, seasonal canopy cover, and stream shading. Species closely associated with deciduous forest and shrub habitats include willow flycatcher (*Empidonax trailii*), yellow warbler (*Dendroica petechia*), MacGillivray's warbler (*Oporornis tolmiei*), black-capped chickadee (*Parus atricapillus*), red-eyed vireo (*Vireo olivaceous*), olive-sided flycatcher (*Contopus cooperi*), and ruffed grouse (*Bonasa umbellatus*).

Timber harvest has affected the distribution of deciduous forests in a number of ways over the past 100 years. The amount of deciduous and mixed forest in the watershed increased over the first half of the twentieth century because cutover lands were typically burned and allowed to regenerate naturally. Red alder became particularly abundant due to its ability to rapidly colonize disturbed soils and out-compete slower growing conifers. In the second half of the twentieth century, advances in silviculture

and increased emphasis on the growth of high-value conifer species resulted in the conversion of many acres of alder forest to conifers, and the active suppression of young alders in regenerating conifer stands. While the total area of deciduous forest has decreased in recent decades, it still remains higher overall than is believed to have existed prior to European settlement. The general distribution of deciduous forest has changed since European settlement. Following the original project construction, the total amount of lowland riparian deciduous forest decreased slightly due to inundation of Lake Shannon and Baker Lake, while the amount of upland deciduous forest (particularly red alder) has increased for the reasons discussed above. Current state and federal regulations prohibit timber harvest directly adjacent to perennial streams in the watershed, so the amount of deciduous forest in these riparian areas is expected to decrease over the next 100 years, eventually approaching the pre-settlement condition.

It is estimated that construction of the Baker River Project affected approximately 90 acres of upland deciduous forest habitats and an additional 269 acres of riparian deciduous forest and shrub (Biota Pacific et al., 2003).

Currently, deciduous forest habitats are present on about 5,592 acres in the Baker River basin and about 450 acres in the project area. Most of these sites are disturbed timber lands, or disturbed lands along the northern shorelines of Lake Shannon and the northwestern shore of Baker Lake. Deciduous shrub habitats comprise about 44 acres within the project area, primarily along the western shorelines of the project reservoirs. Hamer Environmental et al. (2004) includes detailed habitat information on tree species composition, diameter class, canopy cover, coarse woody debris, and snags for sample sites within these habitats.

The Forest Service and State of Washington do not implement specific management guidelines for the protection of deciduous forest and shrub habitats. Many of these habitats are currently protected, and are expected to be protected in the future, under riparian zone management regulations and policies (described in the following section).

### Riparian Habitats

Riparian habitats are located at the interface between terrestrial habitats and aquatic environments. In the Baker River basin, deciduous forest and shrub habitats are characteristic along the active channel of low gradient waterways with well-developed floodplains. Mixed coniferous/deciduous and coniferous forests extend back into the less frequently disturbed portions of the floodplain. Riparian zones narrow with increasing stream gradient, leading to stands of mixed coniferous and deciduous species. Along the narrowest, highest gradient streams, coniferous tree species dominate the overstory. Many wildlife species of riparian habitats are associated with deciduous forest and shrub habitats, as described in the preceding section. Wildlife indicative of riparian habitats,

but not necessarily tied to deciduous plant species, include mink (*Mustela vison*), red-legged frog (*Rana aurora*), Yuma myotis (*Myotis yumanensis*), and harlequin duck (*Histrionicus histrionicus*).

Timber harvest has affected riparian zones in the Baker River basin through clearing of vegetation, road and railroad construction, and modification of drainage. The Forest Service (2002a) estimates that approximately 78 percent of the existing riparian areas on non-federal lands in the basin has been disturbed by timber harvest occurring up to 1990. However, potential for recruitment of LWD, an important function of riparian areas that is related to streamside vegetation structure class, is rated as good on most non-federal lands in the basin (Forest Service, 2002a). On Forest Service lands, an estimated 10 percent of the riparian area has been disturbed by timber harvest. The uppermost watershed is largely rated as low potential for LWD recruitment because of the lack of trees at high elevation; in the mid-elevation portions of the watershed, most Forest Service lands are rated as moderate to high potential. The Forest Service (2002a) also notes that most of the riparian zones in the Baker River basin support vegetation of sufficient age and structure to provide ample stream shading.

A review of functional condition of riparian reserves in the Baker River subbasin is summarized in NMFS (2004a, based on Beamer et al., 2000 as cited in WCC, 2003). Almost 90 percent of the riparian areas within the Mt. Baker watershed administrative unit (WAU) were ranked as functional. Within the Mt. Blum and Lake Shannon East WAUs, less than 60 percent of the riparian areas were rated as functional. Just over 50 percent of the riparian areas in the Lake Shannon West WAU were ranked with functional reaches.

Riparian conditions in the Lower Skagit River are highly disturbed because of extensive agricultural, residential, and urban development. Tree cover, along with the related riparian functions of LWD recruitment and shading, is low. Beamer et al., 2000 (as cited in WCC, 2003) describes riparian conditions along the Lower Skagit River as generally poor. Between the confluences of Grandy Creek and the Town of Sedro-Woolley, approximately 72 to 76 percent of the reaches were described as impaired or moderately impaired. The shorter stretch between Grassmere (immediately downstream of the Town of Concrete) to Grandy Creek was rated as fair, with approximately 45 to 50 percent of reaches rated as impaired or moderately impaired. The Skagit delta, the lowermost end of the riparian zone, has been highly modified by ditching, filling, and diking.

The original development of the Baker River Project affected riparian zones along an estimated 57 miles of streams, including 16 miles of the Baker River (Forest Service, 2002a). Pre-project vegetation mapping delineated the broad floodplain of the Baker River and its vegetation (Biota Pacific et al., 2003). An estimated 2,223 acres of riparian habitats were affected by inundation, including 1,114 acres of coniferous forest, 841

acres of mixed coniferous/deciduous forest, 203 acres of deciduous forest, and 65 acres of shrub habitat.

Under current conditions in the Baker River basin, more than 1,410 miles of stream and 32 miles of reservoir shoreline are present. Eighty-seven percent of the streams in the basin are small, higher gradient streams (Forest Service, 2002a; Class 3 and 4 streams) with very narrow riparian zones. The riparian habitats in the project area are not readily distinguishable from surrounding vegetation at the mapping scale used for the basin, and riparian habitats were not delineated on maps. Riparian zones characterized by mixed coniferous/deciduous forest, deciduous forest, or deciduous shrub were mapped under those cover types, and their habitat features were discussed in the preceding sections.

The Forest Service manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the Northwest Forest Plan (Forest Service and BLM, 1994a). The allocation of Riparian Reserves is intended to provide adequate habitat protection for riparian species, provide travel and dispersal corridors for wildlife, and maintain water quality. State and private timberlands are managed under the Washington State Forest Practices Rules, which specify stream, wetland, and riparian zone protection. The Washington State Shoreline Management Act regulates development and other activities along all shorelines of the state (those adjacent to streams with a mean annual flow of $\geq$ 20 cfs and lakes with a total area $\geq$ 20 acres).

Implementation of federal and state regulations and policies for management of riparian zones is expected to continue in the future, providing long-term protection for these habitats.

### Wetlands and Open Water Habitats

Wetlands in the Baker River basin include forested, scrub/shrub, emergent, and open water habitats of small ponds. The most common tree species associated with forested wetlands are red alder, black cottonwood, and western redcedar. Shrub wetlands in the basin are characterized by various willow species, salmonberry, vine maple, and spiraea (*Spiraea douglasii*). Emergent wetlands in the basin support a variety of sedges, forbs, and grasses, including the common invasive species reed canarygrass (*Phalaris arundinacea*). Wetlands provide valuable plant, fish, and wildlife habitat, and are also valued for their hydrologic functions.

Timber harvest has affected wetlands through clearing of vegetation, ground-disturbing activities, road building, and modification of natural drainage patterns. The majority of the Lake Shannon subwatershed, and significant portions of the Baker Lake subwatershed, were harvested prior to implementation of management policies protecting wetlands.

The original development of the Baker River Project affected wetland habitats associated with the Baker River floodplain, the riparian zones of tributary streams, and isolated wetlands and ponds. The Forest Service estimates that 172 acres of wetlands were inundated by Baker Lake, as well as streamside riparian areas that may have contained wetlands (Forest Service, 2002a). Pre-project cover type mapping (Biota Pacific et al., 2003) indicates that approximately 290 acres of wetland habitats, 15 acres of ponds, and 549 acres of lake (historical Baker Lake) were affected when Baker reservoir was inundated. Inundation of Lake Shannon affected 66 acres of wetlands and 3 acres of pond habitat.

Construction of the project also created the large open-water habitats of the project reservoirs. Emergent wetlands persist within the reservoir boundaries and the reservoirs contribute to the hydrology supporting many of the adjacent wetlands along portions of the shorelines.

Table 3-19 provides a summary of the acreage of current wetland habitats. This evaluation included wetlands within the intermittently inundated portions of the reservoirs as well as those located above reservoir full pool elevation (Hamer Environmental et al., 2004).

Table 3-19. Baker River Project area wetlands (in acres).[a]

| Wetland Type | Lake Shannon Subarea | Baker Lake Subarea | Total Project Area |
|---|---|---|---|
| **Palustrine (Above Reservoir Full Pool)** | | | |
| Forested wetland (PFO) and PFO mosaics | 2 | 18 | 20 |
| Scrub/shrub wetland (PSS) | 0 | 16 | 16 |
| Emergent wetland (PEM) | 0 | 11 | 11 |
| Stream and aquatic bed | 27 | 25 | 52 |
| **Lacustrine (Below Reservoir Full Pool)** | | | |
| Upper perennial—emergent | 0 | 26 | 26 |
| Intermittently inundated—emergent | 79 | 126 | 205 |
| Upper perennial—non-vegetated | 643 | 564 | 1,207 |
| Intermittently inundated—non-vegetated | 172 | 1,651 | 1,823 |
| Lower perennial lacustrine (reservoir)[b] | 1,220 | 2,384 | 3,604 |
| **All Wetlands** | **2,143** | **4,821** | **6,964** |

[a] Sources: Hamer Environmental et al., 2004

[b] Reservoir surface area near minimum pool as interpreted from aerial photography dated March 4 and March 6, 2001.

The majority of palustrine forested, scrub/shrub, and emergent wetlands are located at the northern end and along the western side of Baker Lake. Over 16 acres of scrub/shrub wetlands are present and are dominated by salmonberry and/or Sitka willow (*Salix sitchensis*). Forested wetlands and mosaics total 20 acres and include red alder dominated sites, mixed conifer-deciduous sites (typically characterized by red alder and western hemlock), and wetland/upland mosaic sites (typically dominated by red alder with western hemlock and western redcedar). Less than two acres of forested wetland are located near Lake Shannon. Herbaceous emergent wetlands total about 11 acres at Baker Lake; the majority of these contained the invasive species reed canarygrass.

One emergent wetland (WB-30)[25] located in the Little Sandy Creek wetland complex contains many bog features, including understory cover dominated by sphagnum moss (*Sphagnum* spp.), and stunted western hemlock and western redcedar trees (Hamer Environmental et al., 2004). Several other wetlands at the Sandy Creek complex have high functions and values scores for plant composition, species diversity, and/or structural complexity. A total of six wetlands meeting the WDFW priority habitat "bog-fen-marsh" criteria were recorded; four of these sites are at Lake Shannon and two are located in and south of the Little Sandy Creek wetland complex (Hamer Environmental et al., 2004).

An estimate of the source of supporting wetland hydrology was made for each palustrine wetland site, based on field observations. Of 33 wetlands evaluated at Baker Lake, 5 (13 acres) were categorized as being supported solely by Baker Lake, 10 were rated as being supported solely by shallow groundwater and/or groundwater discharge (16 acres), and 18 (62 acres) were rated as supported by a combination of Baker Lake and groundwater hydrology. High value wetlands at the Sandy Creek complex (WB-21, 22, 23, 28, and 30) all are believed to have hydrology provided by a combination of Baker Lake, shallow groundwater, and/or groundwater discharge. Monitoring of water levels in wetland WB-30 was conducted to determine how strongly the wetland is influenced by Baker Lake hydrology. Results of the monitoring indicate that shallow ground water is the primary source of supporting wetland hydrology for WB-30 (Evergreen Aquatic Resource Consultants, 2004). Water surface elevations within the wetland appeared to be independent of the water surface elevations of Baker Lake, except when the reservoir was at or near full pool. The lowermost portion of the wetland was inundated by the Baker Lake full pool; however, the effect of inundation on hydrology of WB-30 appeared to be limited in geographic area, frequency, and duration.

At Lake Shannon, nine wetlands were evaluated; of these, four wetlands (3 acres) were categorized as being supported solely by shallow groundwater and/or groundwater discharge, and five wetlands (8 acres) were thought to be supported by a combination of Lake Shannon and groundwater hydrology.

[25] Individual wetlands are shown in Hammer Environmental et al., 2004.

The lacustrine habitats below reservoir full pool elevation were grouped into three categories depending upon the degree of inundation (table 3-19). The upper perennial category denotes areas that are saturated to the surface with water year-round, such as the lands bordering stream outlets. Intermittently inundated wetlands are those that are above the minimum operating pool level and are dry for some portion of the growing season. Lower perennial wetlands are below the minimum operating pool level and are, therefore, permanently inundated by the reservoirs. Lacustrine emergent wetlands are present within the upper perennial and intermittently inundated categories in both the Lake Shannon and Baker Lake reservoirs. Within-reservoir emergent wetlands total 152 acres at Baker Lake and 79 acres at Lake Shannon. These emergent wetlands are dominated by grass/forb type vegetation including sedges of the genus Carex, rushes of the genus Juncus, spearwort buttercup (*Ranunculus flammula*), and reed canarygrass. Large expanses of exposed non-vegetated ground are present within the reservoir at Baker Lake (2,215 acres), mostly along the shallow delta area at the northern end and along the western perimeter. Non-vegetated ground exposed at lower pool elevations at Lake Shannon totals 815 acres, most of which is located in the northern half of the reservoir.

We summarize general wetland types within the Baker River basin in table 3-20. Approximately 345 acres of forested wetlands, 289 acres of scrub/shrub wetlands, and 248 acres of emergent wetlands are present in the basin. These values likely under-represent actual wetland acres in the Baker River basin because they are based on aerial photography interpretation of vegetation. Forested wetlands and small, non-forested wetlands are often misclassified as upland or riparian forest when determinations are based solely on remote data.

Reservoir elevations fluctuate on a daily and seasonal basis at Baker Lake. Normal full pool for Baker Lake is 727.77 feet msl; surface area at this elevation is approximately 4,977 acres. For purposes of flood storage, Baker Lake is maintained at or below 724.50 feet msl by November 1 and at no more than 711.56 feet msl under normal operating conditions from November 15 to March 1, under current agreement with the Corps. Minimum reservoir levels typically occur from November through March or early April. Baker Lake is maintained at or near full pool during the summer. Based on the past 20 years of monthly median values, Baker Lake was within 10 feet of full pool from June through October, and, at its minimum, about 30 feet below full pool during March. Water levels may vary several feet on a daily basis.

Table 3-20. Baker River basin wetland acreages.[a] (Source: R2, 2003j)

| Wetland Type | Modifier | Total Baker River Basin (acres) | Percent of Total |
|---|---|---|---|
| **Palustrine** | | | |
| | Forested (PFO) | 345 | 23.2 |
| | Scrub/shrub (PSS) | 289 | 19.4 |
| | Emergent (PEM) | 248 | 16.6 |
| | Aquatic bed | 3 | 0.2 |
| | Open water | 62 | 4.1 |
| **Riverine** | | | |
| | Upper perennial | 275 | 18.5 |
| **Lacustrine** | | | |
| | Natural lakes | 269 | 18.0 |
| **Total** | | 1,491 | 100.0 |

[a] The R2 (2003j) estimates of habitat area have not been adjusted to reflect the shift to NAVD 88 and may differ from published figures used elsewhere in this document.

Lake Shannon full pool is 442.35 feet msl; surface area at this elevation is approximately 2,273 acres. Over the past 20 years, monthly median water levels were within 10 feet of full pool between June and December, and within 5 feet of full pool for the months of July, August, September, and November. The lowest monthly median level was approximately 33 feet below full pool during March.

Erosion occurs along portions of the reservoir shorelines in the current condition, and can result in disturbance and loss of shoreline vegetation. Puget conducted an evaluation of shoreline erosion (AESI, 2003) and determined that the primary cause of erosion along the shoreline and in the drawdown zone is undercutting, either by wave or stream action, or a combination of both. The shoreline of Baker Lake is affected by high to severe erosion along approximately 11 percent of its length. Low to moderate erosion affects an estimated 37 percent, and no erosion was occurring on 52 percent of the shoreline. At Lake Shannon, high to severe erosion affects 14 percent of the shoreline. Low to moderate erosion currently occurs on 70 percent, and no erosion occurs on 16 percent of the shoreline. The AESI (2003) study did not determine the rates of shoreline erosion, nor did it compare reservoir shoreline erosion with natural riverbank erosion in the Baker River basin upstream and downstream of the project. Bank erosion and undercutting are common occurrences in high-energy, glacially fed systems such as the Baker River and are important sources of coarse bedload, sediment, and LWD (Benda and Sias, 1998; Collins et al., 2002; Murphy and Koski, 1989). Vegetation surveys in the project area recorded sightings of shoreline erosion thought to be a result of reservoir fluctuation (Hamer Environmental et al., 2004). Twelve sites were recorded, two on Baker Lake and ten on Lake Shannon. One of the sites was described as a narrow piece

of land surrounded by reservoir on three sides, and exhibiting extremely undercut banks. The remaining 11 sites exhibited erosion only along the reservoir-facing side of the site. No estimates of area of the sites were provided.

Puget implements a number of measures to assess and protect wildlife habitats associated with the project reservoirs. Surveys of bald eagle (*Haliaeetus leucocephalus*) use of the reservoirs during wintering and breeding seasons were initiated in 1980 (Puget, 2002f). These surveys were expanded to include observation of waterfowl use of the reservoirs and osprey (*Pandion haliaetus*) nesting use of the reservoirs. Monthly surveys have been performed during December through September since 1980. Puget has installed several osprey nest structures to replace decayed snags and stumps in Lake Shannon. Other wildlife activities have included developing an osprey-safe screening material for excluding herons from the trout rearing ponds. Management measures for the protection of an existing bald eagle nest on National Forest System lands at Baker Lake have been implemented, including road closure, signing of the sensitive wildlife site, and scheduling of project-related activities to occur outside of the nesting period. These measures were implemented in coordination with the Forest Service.

The Forest Service manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the Northwest Forest Plan (Forest Service and BLM, 1994a). The allocation of Riparian Reserves is intended to provide adequate habitat protection for riparian species, provide travel and dispersal corridors for wildlife, and maintain water quality. State and private timberlands are managed under the Washington State Forest Practices Rules, which specify stream, wetland, and riparian zone protection. The Washington State Shoreline Management Act regulates development and other activities along wetlands that fall within or are contiguous with shorelines of the state.

Implementation of federal and state regulations and policies for management of wetlands, water quality, riparian areas, and shorelines of the state is expected to continue in the future, providing long-term protection for these habitats.

### Other Non-Forested Habitats

Non-forested habitats in the project area (excluding shrub and emergent wetlands and project facilities) include grass/forb habitats, bare soil, and cliffs/talus/rock outcrops (table 3-17). Grass/forb habitats in the project area total about 351 acres and are comprised predominantly of emergent wetlands within the reservoir drawdown zones. These wetlands are dominated by sedges, rushes, reed canarygrass, and spearwort buttercup (refer to the Wetlands and Open Water Habitats section above). Bare soil (one acre) in the project area likely represents a recently disturbed site.

Three acres of cliffs and one acre of unvegetated upland were mapped in the Pro project area. Because of their small size and steep slopes, cliffs, rock outcrops, and small talus fields in the project area were likely underrepresented by the vegetation mapping (Hamer Environmental et al., 2004). Field observations of these WDFW priority habitat sites were recorded (Hamer Environmental et al., 2004) and totaled 14 cliff areas, 15 talus sites, and 2 talus sites with rock outcrops. Rock faces, cliffs, and talus slopes may provide habitat for wildlife species, such as the peregrine falcon (*Falco peregrinus*), golden eagle (*Aquila chrysaetos*), and big brown bat (*Eptesicus fuscus*).

In the Baker River basin, grass/forb/sparsely vegetated cover types total over 26,000 acres, the majority of which are located in high elevation meadows and slopes (table 3-18). Rock/talus/bare soil totals 19,328 acres, primarily at high elevation in the Baker Lake subbasin. The mapping category "water" includes snowfields and glaciers, as well as reservoirs and major lakes, totaling 21,125 acres in the watershed.

Puget does not specifically manage the non-forested habitats described above. No federal management designation is given to these habitat types. The WDFW provides management recommendations for Priority Species and Habitats, including caves, cliffs, and talus. Within the Baker River basin, most of these habitats are located within LSRs or other management designations with high levels of protection from human activity other than recreation.

### Project Facilities

The Lower Baker Development includes the Lower Baker dam, powerhouse, and associated facilities at the southern end of the Lake Shannon reservoir, all located within the Town of Concrete city limits.

The Upper Baker Development includes the Upper Baker dam and powerhouse, West Pass and pumping pond dikes, downstream fish passage facilities, and other associated facilities. Sockeye Spawning Beaches 2 and 3 are located at the head of the lake, west of the Baker River. Sockeye Spawning Beach 4 is located at the northern end of Lake Shannon on the western shore.

Additional office facilities for the Baker River Project are located within the Town of Concrete.

### Plant Species and Habitats of Special Concern

**Special Status Plant Species and Habitats**—This section describes the documented occurrences of special status plant species in the vicinity of the Baker River Project. Special status plant species include Washington State threatened, endangered, and sensitive species (WNHP, 2004a) and Forest Service sensitive species (Forest Service, 2004a). WDFW priority habitats are also noted. Species protected under the

ESA, as well as federal candidates for protection, are discussed in section 3.3.6, Federally Listed Threatened and Endangered Species and Essential Fish Habitat. One federally listed (and state endangered) species, golden paintbrush (*Castilleja levisecta*), was recorded historically in Skagit County. No federally listed, proposed, or candidate plant species or species of concern are known to occur in the project area.

A wide range of habitats support rare plants in the Baker River basin, including emergent, shrub, and forested wetlands; mature and old-growth coniferous forest; deciduous forest; streambanks; talus slopes; and alpine meadows. Timber harvest, road building, and hydroelectric development have cumulatively affected forest and wetland habitats at low to mid-elevations in the basin. The Forest Service estimates that potential suitable habitat for 13 Region 6 sensitive plant species was affected by inundation of the Baker Lake reservoir (Forest Service, 2003a), although no direct evidence exists of the presence of the plants in the project area prior to inundation.

Surveys for rare plants were conducted in June through September 2002 at Project-related dispersed recreational sites and in wetlands that are hydrologically influenced by the project reservoirs (Hamer Environmental and R2, 2003a). Supplemental rare plant surveys were conducted during the summers of 2003 and 2004 (Hamer Environmental and R2, 2003b; Hamer Environmental, 2004). Other sources of information include Forest Service rare plant surveys and Washington Natural Heritage Program (WNHP) records. Special status species occurrences are summarized in table 3-21 and are discussed below. The habitat requirements for many of these species are largely unknown, and potential habitat may occur within the project area. One state threatened plant species has been recorded in the project vicinity. Canyon bog-orchid (*Platanthera sparsiflora*) has been documented at a single site near the mouth of Noisy Creek. This orchid ranges from extreme southwestern Oregon to Baja and is considered at the northern edge of its range in northern Washington (Hitchcock et al., 1969; Forest Service, 2002a). Canyon bog-orchid is designated sensitive by the Forest Service.

Six species designated as state sensitive have been documented in the project vicinity. These include bristly sedge (*Carex comosa*), yellow sedge (*Carex flava*), long-styled sedge (*Carex stylosa*), northern rice root (*Fritillaria camschatcensis*), Canadian St. Johnswort (*Hypericum majus*), and ground pine (*Lycopodium dendroideum*). The *Baker River Watershed Analysis* (Forest Service, 2002a) indicates that the identification of northern rice root is uncertain. The above-listed species are also designated as sensitive by the Forest Service Region 6 (Forest Service, 2004a).

Bristly sedge has been reported from a single location just outside the Baker River basin near Grandy Lake (approximately 2 miles from the project).

Yellow sedge was observed at the north end of Baker Lake near the full pool boundary. Surveys during 2003 (Hamer Environmental and R2, 2003b) documented

several hundred plants growing within reed a canarygrass meadow, a red alder forested wetland, and along a streambank.

Long-styled sedge has been recorded from one site on the Sulphur Creek lava flow (approximately 5 miles from the project). It is a wetland species found in marshes, bogs, and wet meadows and along shorelines at low to upper elevations (Pojar and MacKinnon, 1994).

Northern rice-root was tentatively identified from an area in the upper Sulphur Creek drainage (WNHP, 2004b), approximately 8 miles from the project. This species inhabits moist areas, including open meadows and streambanks (Pojar and McKinnon, 1994).

Canadian St. Johnswort was reported by the Forest Service at one site near Shannon Creek (Forest Service, 2002a; WNHP, 2004b) near the project boundary. This species inhabits wet sites and is likely near the southern edge of its range in the project vicinity (Hitchcock et al., 1969).

Table 3-21. Special status plant species in the Baker River basin.

| Common Name | Scientific Name | Federal Status | State Status | Habitat Requirements | Occurrence in Baker River Basin |
|---|---|---|---|---|---|
| **Vascular Plants** | | | | | |
| Bristly sedge | *Carex comosa* | Forest Service Sensitive | State Sensitive | Marshes, lakeshores, wet meadows[a] | 1 site just outside of basin, near Grandy Lake[b] |
| Yellow sedge | *Carex flava* | Forest Service Sensitive | State Sensitive | Wet, usually sandy meadows, sometimes on calcareous soils, low to mid elevations[c] | 1 site: North end of Baker Lake, northeast shore[d,e] |
| Long-styled sedge | *Carex stylosa* | Forest Service Sensitive | State Sensitive | Bogs, fens, marshes, wet meadows, streambanks, shorelines, low to high elevations, coasts[f] | 1 site: Sulphur Creek lava flow[e] |
| Northern rice root | *Fritillaria camschatcensis* | Forest Service Sensitive | State Sensitive | Moist open places, meadows, streambanks, shorelines and saltmarsh edges, sea level to subalpine[f] | 1 site: Sulphur Creek lava flow[b,e]; ID uncertain[g] |
| Boreal bedstraw | *Galium kamtschaticum* | Forest Service Sensitive | -- | Moist coniferous forest (especially alluvial), streambanks, grassy or mossy talus slopes, low to middle elevations[f] | Several sites: Marten Lake Road, upper Shannon Creek, Boulder Ridge, Jackman Creek drainage[b,d] |

| Common Name | Scientific Name | Federal Status | State Status | Habitat Requirements | Occurrence in Baker River Basin |
|---|---|---|---|---|---|
| Canadian St. Johnswort | *Hypericum majus* | Forest Service Sensitive | State Sensitive | Moist open sites[a] | 1 site[b,g] |
| Ground pine | *Lycopodium dendroideum* | Forest Service Sensitive | State Sensitive | Moist to fairly dry, deciduous and coniferous forests, thickets, openings and bog edges, low to middle elevations[f] | Several sites: Morovitz Pond, Noisy Creek, Sulphur Creek lava flow, Shadow of Sentinels Trail[b,e,g,h] |
| Canyon bog-orchid | *Platanthera sparsiflora* | Forest Service Sensitive | State Threatened | Wet, mostly boggy areas, extreme SW Oregon to Baja[a] | 1 site: Noisy Creek[b,e,g,h] |
| **Fungi, Lichens, Liverworts and Mosses** | | | | | |
| Lichen | *Dendriscocaulon intracatulum* | Forest Service Sensitive | -- | | 2 sites: Sulphur Creek lava flow[e] |
| Liverwort | *Herbertus aduncus* | Forest Service Sensitive | -- | | 1 site near Concrete[g] |
| Lichen | *Nephroma occultum* | Forest Service Sensitive | -- | | 1 site: Sulphur Creek[g] |

| Common Name | Scientific Name | Federal Status | State Status | Habitat Requirements | Occurrence in Baker River Basin |
|---|---|---|---|---|---|
| Lichen | *Pannaria saubinetii* | Forest Service Sensitive | -- | | 1 site: Lower Rocky Creek[e] |
| Lichen | *Pilophorus nigricaulis* | Forest Service Sensitive | -- | | 3 sites: near Artist's Point, Sulphur Creek[g] |
| Lichen | *Platismatia lacunosa* | Forest Service Sensitive | -- | | 1 site: Little Sandy Creek outlet[d,e] |
| Lichen | *Pseudocyphellaria rainierensis* | Forest Service Sensitive | -- | | 2 sites: near Shadow of the Sentinels Trail, along Baker Lake Road near Boulder Creek[e] |
| Moss | *Rhizomnium nudum* | Forest Service Sensitive | -- | | 2 sites: Schreibers Meadow, Sulphur Creek[g] |
| Fungus | *Sarcosoma latahense* | Forest Service Sensitive | -- | | 1 site: Sandy Creek[g] |

| Common Name | Scientific Name | Federal Status | State Status | Habitat Requirements | Occurrence in Baker River Basin |
|---|---|---|---|---|---|
| Moss | *Schistostega pennata* | Forest Service Sensitive | -- | | Numerous sites: Schreibers Meadows, Boulder Ridge, Park Creek Campground, Panorama Point Campground, Little Sandy Creek outlet, West Pass dike, Swift Creek south of Baker Lake Road, Baker River at head of Baker Lake[d,e,g,i] |
| Moss | *Tetraphis geniculata* | Forest Service Sensitive | -- | | 1 site: Sandy Creek outlet[d,e] |
| Liverwort | *Tritomaria quinquedentata* | Forest Service Sensitive | -- | | 1 site: Swift Creek[g] |
| Lichen | *Usnea longissima* | Forest Service Sensitive | -- | | Multiple sites[j, k] |

Notes:

**Federal Status:**

Endangered–Species in danger of extinction throughout all or a significant portion of its range; protected under ESA.

Threatened–Species likely to become endangered within the foreseeable future throughout all or a significant portion of its range; protected under ESA.

Candidate–Species considered for possible addition to the list of endangered and threatened species.

Species of concern–Species for which the FWS does not have sufficient information to support a listing proposal at this time.

Forest Service sensitive– Species listed by the Forest Service Regional Forester (Forest Service, 2004a).

**State Status:**

Endangered–Any taxon in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue.

| Common Name | Scientific Name | Federal Status | State Status | Habitat Requirements | Occurrence in Baker River Basin |
|---|---|---|---|---|---|

Threatened–Any taxon likely to become endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation continue.

Sensitive–Any taxon that is vulnerable or declining and could become endangered or threatened in the state without active management or removal of threats.

[a] Hitchcock et al. (1969).
[b] WNHP (2004b).
[c] Hurd et al. (1998).
[d] Hamer Environmental and R2 (2003a).
[e] Forest Service (2003b).
[f] Pojar and MacKinnon (1994).
[g] Forest Service (2002a).
[h] Puget (2002b).
[i] Hamer Environmental and R2 (2003b).
[j] Hamer Environmental (2004).
[k] Forest Service, 2004a.

Ground pine inhabits moist to dry sites in North American boreal forests from Alaska to Newfoundland, extending into southern Washington (Flora of North America Editorial Committee, 1993). A large population of several thousand stems is present on the Sulphur Creek lava flow (Forest Service, 2002a; Puget, 2002b), approximately 5 miles from the project. It has also been observed at several other sites in the Baker River basin and may be present within the project area.

Boreal bedstraw (*Galium kamtschaticum*) is a Forest Service sensitive species formerly designated by the state as sensitive. It has been documented at several sites in the basin (WNHP, 2004b). This species inhabits moist streambanks, slopes, and coniferous forests from northern Washington north to Southeast Alaska. It is considered at the edge of its range at Snoqualmie Pass, Washington (Forest Service, 2002a). This species has not been recorded in the project area.

Three Forest Service sensitive non-vascular plant species were observed during surveys of dispersed campsites and wetland habitats in and near the project area. *Schistostega pennata* was observed at an informal recreational site near the outlet of Swift Creek. It was also observed at six wetland sites near the project reservoirs, and has been recorded by the Forest Service at many higher elevation sites in the basin. The species was observed in wetland-upland mosaic or forested wetlands varying from young mixed riparian forest to old-growth open conifer forest. *S. pennata* was found growing on mineral soil within the root mass of upturned trees.

*Tetraphis geniculata* was observed at one location during the 2002 surveys. The plant was growing on the moist vertical face of a rotting log within an old-growth forest wetland in the Little Sandy Creek wetland complex. *Platismatia lacunosa* was observed at the Little Sandy Creek wetland complex during project surveys in 2002. Three thallus bodies were located on downed red alder branches within a mid- to mature-aged red alder forested wetland. Additional plants may have been present in the canopy of the red alder trees.

The Forest Service sensitive lichen *Usnea longissima* was observed on privately owned lands during the 2004 survey of the proposed FSC launch site. The plants were growing on vine maple branches along the shrubby border between upland forest and lakeshore (Hamer Environmental, 2004).

Several WDFW priority habitats are present in the project area and the Baker River basin: old-growth/mature forest, riparian habitat, wetlands and fresh deepwater habitats, cliffs and talus, and snag/log habitat (table 3-22). The occurrence and distribution of these habitats are discussed in section 3.3.5.1, Plant Communities and Wildlife Habitats.

Future management of federal and private lands is expected to continue providing protection for special status species and habitats per current regulations and policy.

**Noxious Weeds and Other Invasive, Non-Native Plant Species**—Washington Weed Law (Chapter 17.10 RCW) requires that noxious weeds be controlled to limit adverse economic effects on agricultural, natural, and human resources of the state. Noxious weeds are plants that, when established, are highly destructive, competitive, or difficult to control by cultural or chemical practices. The State Noxious Weed Control Board updates its list of noxious weeds annually and categorizes the species into three classes. The State Board coordinates noxious weed control activities throughout the state via County Weed Districts and County Noxious Weed Control Boards. Management goals for noxious weed species may range from complete eradication to containment of the species within a currently infested area.

Table 3-22. Washington State WDFW priority habitats in the Baker River basin.[a] (Source: WDFW, 2003a; WDFW, 2004)

| Priority Habitat | WDFW Definition (abbreviated) | Occurrence in Baker River Basin |
|---|---|---|
| Old-growth and mature forests | At least two species, at least 20 trees/hectare >32 inches in diameter at breast height (dbh), plus large snags and downed logs. Mature forests: average dbh > 21 inches, typically 80 to 200 years old. | Present in project area and basin. Refer to Plant Communities and Wildlife Habitats discussion in section 3.3.5.1, Terrestrial Resources. |
| Riparian | Area adjacent to aquatic ecosystems containing elements of both aquatic and terrestrial ecosystems. | Present in project area and basin. Refer to Plant Communities and Wildlife Habitats discussion in section 3.3.5.1, Terrestrial Resources. |
| Freshwater wetlands and fresh deep-water habitats | Wetlands per federal and state definition. Fresh deep-water habitats are permanently flooded lands below wetlands. | Present in project area and basin. Refer to Plant Communities and Wildlife Habitats discussion in section 3.3.5.1, Terrestrial Resources. |
| Snags and logs | Snags: dbh ≥ 20 inches, height ≥ 6.5 feet; logs: dbh 12 inches at large end, length ≥ 20 feet. | Present in project area and basin as components of major habitat types. Refer to Plant Communities and Wildlife Habitats discussion in section 3.3.5.1, Terrestrial Resources. |
| Cliffs/talus | Cliffs >25 feet high, below 5,000 feet elevation; talus: homogeneous areas of rock rubble 0.5 to 6.5 feet in size. | Observed in project area; numerous sites present higher in the Baker River basin |

[a] Priority habitats – Habitats or elements with unique or significant value to a diverse assemblage of species.

Class A species are those noxious weeds not native to the state that are of limited distribution or are unrecorded in the state. Eradication of all Class A species is required by state law. State Class A species are listed on all County Class A weed lists.

Class B species are those noxious weeds not native to the state that are of limited distribution or are unrecorded in a region of the state, and that pose a serious threat to the region. These species are treated differently in different regions of the state, based on their distribution. In regions where a Class B species is of limited distribution or unrecorded, the species is designated for control under state law (Class B designate species). Prevention of seed production is required for Class B designates. In regions where a Class B species is already widespread, control is an option of the local weed board.

Class C weeds may be widely established in Washington, or may be of species interest to the agricultural industry. Control of these species, and of Class B non-designates, is a local weed board option.

The State of Washington also maintains a monitor list of non-native species. Species may be included on the list for a variety of reasons including the need for information on distribution and biology, the need to verify occurrence, and the need to monitor reoccurrence. There is no regulatory or legal authority associated with the monitor weed list. The major federal authorities for management of non-native plants are the Plant Protection Act (Title IV of the Agricultural Risk Protection Act of 2000), the Amendment to the Federal Noxious Weed Act of 1974, and Executive Order 13112 on Invasive Species of 1999. The Forest Service implements measures to prevent the introduction and control the spread of noxious weeds on National Forest System lands. Forest Service management must comply with the objectives, standards, and guidelines of the Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan (LRMP) (Forest Service, 1990), as well as federal law and direction. Regional Forest Service direction (Forest Service, 1988, 1989) is currently being updated and clarified in a draft environmental impact statement (EIS) about management of non-native and invasive plants, released in 2004 (Forest Service, 2004b).

A forest-wide EA was completed for the Mt. Baker-Snoqualmie National Forest in 1999 (Forest Service, 1999). This EA addresses site-specific treatment for known weed infestations and includes a comprehensive appendix outlining best management practices for prevention of noxious weeds. The best management practices have been incorporated as Amendment #14 in the Mt. Baker-Snoqualmie National Forest LRMP (Forest Service, 1990). The 1999 EA recommended control measures for several Japanese knotweed sites in the vicinity of the Baker River Project.

Weed species known to occur in the Baker River Project vicinity are shown in table 3-23. This information is compiled from existing data provided by Skagit and

Whatcom counties, Forest Service, as incidental finds during Puget rare plant surveys conducted in 2002 (Hamer Environmental and R2, 2003a; Hamer Environmental, 2004), and as observed during weed surveys of the project area conducted during summer 2003 (Hamer Environmental and R2, 2003c).

Table 3-23. Noxious weeds and invasive, non-native plant species in the Baker River Project vicinity.

| Common Name | Scientific Name | State Status[a] | Skagit County Status[b] | Whatcom County Status[c] | Forest Service Management Recommendations[d] | Occurrence in Baker River Basin |
|---|---|---|---|---|---|---|
| **Class A Weed Species** | | Class A | Class A | Class A | | None known to occur |
| **Class B Designates** | | Class B Designate | Class B Designate | Class B Designate | | None known to occur |
| **Class B Weeds, Non-Designates** | | | | | | |
| Scotch broom | *Cytisus scoparius* | Class B | Class B, Priority Status | Class B, targeted for educational or biological efforts | Manage per county direction | Eight populations: Near Lake Shannon boat ramp; Lower Baker River, Upper Baker dam, Park Creek[e] |
| Wild carrot | *Daucus carota* | Class B | Class B, Priority Status | Not Listed | Manage per county direction | Four populations in Skagit Co: Near Lake Shannon boat ramp, Lower Baker River[e] |

| Common Name | Scientific Name | State Status[a] | Skagit County Status[b] | Whatcom County Status[c] | Forest Service Management Recommendations[d] | Occurrence in Baker River Basin |
|---|---|---|---|---|---|---|
| Herb Robert | *Geranium robertianum* | Class B | Class B, Priority Status | Not Listed | Manage per county direction | 31 populations: South end Lake Shannon, Upper Baker dam, Depression Lake, several sites around Baker Lake[e]**;** Baker Lake Road near junction with Forest Road 12[f]**;** FSC and Lower Baker powerhouse sites[i] |
| Smooth hawkweed | *Hieracium laevigatum* | Class B | Class B, Priority Status | Class B, targeted for educational or biological efforts; priority species for 2004 | Manage per county direction | Near Upper Baker dam |
| Hairy cat's-ear | *Hypochaeris radicata* | Class B | Class B, Priority Status | Not Listed | Not Proposed for Treatment | Upper Baker dam, various sites around Baker Lake and Lake Shannon[h]; FSC site[i] |

| Common Name | Scientific Name | State Status[a] | Skagit County Status[b] | Whatcom County Status[c] | Forest Service Management Recommendations[d] | Occurrence in Baker River Basin |
|---|---|---|---|---|---|---|
| Oxeye daisy | *Leucanthemum vulgare* | Class B | Class B, Priority Status | Not Listed | Not Proposed for Treatment | Depression Lake, Upper Baker dam, various sites around Baker Lake; Lake Shannon at Thunder Creek, near Upper Baker dam, near boat ramp[h]; FSC and Lower Baker powerhouse sites[i] |
| Japanese knotweed | *Polygonum cuspidatum* | Class B | Class B, Priority Status | Class B, targeted for educational or biological efforts; priority species for 2004 | Eradicate | Junction of Baker Lake Road and Forest Road 1106, Little Sandy Creek, and near Sandy Creek[f]; Baker Lake Road at Grandy Creek[g] |
| Giant knotweed | *Polygonum sachalinense (P. glandulifera)* | Class B | Class B | Class B, targeted for educational or biological efforts; priority species for 2004 | Eradicate | Baker Lake Road near Shannon Creek[f] |

| Common Name | Scientific Name | State Status[a] | Skagit County Status[b] | Whatcom County Status[c] | Forest Service Management Recommendations[d] | Occurrence in Baker River Basin |
|---|---|---|---|---|---|---|
| Tansy ragwort | *Senecio jacobaea* | Class B | Class B, Priority Status | Class B, targeted for educational or biological efforts; priority species for 2004 | Manage per county direction | Lower Baker dam, Welker Creek[e]; Anderson Point[e,f] |
| **Class C Weed Species** | | | | | | |
| Canada thistle | *Cirsium arvense* | Class C | Class C, selected for control | Class C, targeted for educational or biological efforts | Manage per county direction | Various sites along Baker Lake Road[f]; numerous sites around Lake Shannon, north and south ends of Baker Lake[e] |
| Bull thistle | *Cirsium vulgare* | Class C | Class C | Class C, targeted for educational or biological efforts | Manage per county direction | Numerous sites around Lake Shannon, Upper Baker dam, and north end Baker Lake[e]; FSC site[i] |
| Field bindweed | *Convolvulus arvensis* | Class C | Class C | Not Listed | Manage per county direction | Southeast shore Lake Shannon near boat ramp[h] |

| Common Name | Scientific Name | State Status[a] | Skagit County Status[b] | Whatcom County Status[c] | Forest Service Management Recommendations[d] | Occurrence in Baker River Basin |
|---|---|---|---|---|---|---|
| English ivy | *Hedera* spp. | Class C | Class C | Class C, targeted for educational or biological efforts | Eradicate | Five populations: South end of Lake Shannon, Lower Baker River, Concrete, and one site at Baker Lake former spawning beach.[e] |
| St. Johnswort | *Hypericum perforatum* | Class C | Class C | Class C, targeted for educational or biological efforts | Not Proposed for Treatment | Depression Lake, Upper Baker dam, numerous sites around Baker Lake; Lake Shannon at Thunder Creek, southwest shore, southeast shore near boat ramp[h]**;** FSC and Lower Baker powerhouse sites[i] |
| Reed canarygrass | *Phalaris arundinacea* | Class C | Class C | Class C, targeted for educational or biological efforts | Contain, and where feasible and consistent with other objectives, control or eradicate in six designated wetlands and *Carex flava* site. | Perimeter of Lake Shannon and Baker Lake and adjacent areas[e,f,i] |

| Common Name | Scientific Name | State Status[a] | Skagit County Status[b] | Whatcom County Status[c] | Forest Service Management Recommendations[d] | Occurrence in Baker River Basin |
|---|---|---|---|---|---|---|
| Common tansy | *Tanacetum vulgare* | Class C | Class C | Class C, targeted for educational or biological efforts | Manage per county direction | Southeast of Upper Baker dam on Baker Lake, Southeast shore Lake Shannon near boat ramp[h] |
| **Monitor Weed Species** | | | | | | |
| Watercress | *Rorippa nasturtium-aquaticum* | Monitor | Not Listed | Not Listed | Not Listed | Southeast of Upper Baker dam on Baker Lake[h] |
| **Other Invasive Non-Natives** | | | | | | |
| Butterfly bush | *Buddleia* sp. | Not listed | Not listed | Not listed | Not listed | |
| **Unidentified Species Within Weed Genera** | | | | | | |
| Hawkweed | *Hieracium* sp. | | | | | Baker Lake Road, near Koma Kulshan Guard Station[f] |

| Common Name | Scientific Name | State Status[a] | Skagit County Status[b] | Whatcom County Status[c] | Forest Service Management Recommendations[d] | Occurrence in Baker River Basin |
|---|---|---|---|---|---|---|

[a] Washington State Noxious Weed Control Board (2004).
[b] Skagit County Noxious Weed Control Board (2004).
[c] Whatcom County Noxious Weed Control Board (2004).
[d] Enclosure II to a letter from Y.R. Iwamoto, Acting Forest Supervisor, Mt. Baker-Snoqualmie National Forest, Mountlake Terrace, WA, to C. Freeland, Relicensing Program Manager, Puget, Bellevue, WA, dated December 24, 2003.
[e] Hamer Environmental and R2 (2003c).
[f] Forest Service (2003c).
[g] Forest Servoce (2002a).
[h] Hamer Environmental and R2 (2003a).
[i] Hamer Environmental (2004).

No Class A weed species are currently known to occur in the Baker River Project vicinity. At this time, no Class B weed species designated for control in either Skagit or Whatcom counties are known to occur. A hawkweed (Hieracium sp.) was recorded at one location in the project vicinity, but was not identified to species. This genus contains some species on the Class A and Class B designate lists. Surveys conducted in 2003 did not include identification of this genus to the species level.

The following Class B non-designate and Class C species were observed in the project. Canada thistle (*Cirsium arvense*) was reported at several sites along the Baker Lake Highway and along the shorelines of Baker Lake and Lake Shannon. Bull thistle (*Cirsium vulgare*) was observed at several sites at both reservoirs. Field bindweed (*Convolvulus arvensis*) was observed near the Lake Shannon boat ramp during 2002 rare plant surveys. Scotch broom (*Cytisus scoparius*) was reported from eight sites, primarily in disturbed habitats near the Upper and Lower Baker River Project facilities, but also from one site near Park Creek. Wild carrot (*Daucus carota*) was observed at four sites near the Lake Shannon boat ramp and along the Lower Baker River. Herb Robert (*Geranium robertianum*) was present at numerous sites around Baker Lake and project facilities and Upper and Lower Baker dams. English ivy (*Hedera* spp.) was observed at one site at the north end of Baker Lake and additional sites near Lower Baker dam and the Lower Baker River. Smooth hawkweed (*Hieracium laevigatum*) was noted from one site near Upper Baker dam. St. Johnswort (*Hypericum perforatum*) was recorded at numerous sites around Baker Lake and Lake Shannon.

Hairy cat's-ear (*Hypochaeris radicata*) was observed at Upper Baker dam and several sites around the reservoirs. Oxeye daisy (*Leucanthemum vulgare*) was observed at numerous disturbed sites around both reservoirs. Reed canarygrass (*Phalaris arundinacea*) was reported to be present in a nearly continuous band along the shorelines of both reservoirs. It was also noted in several wetlands outside of the reservoirs. Japanese knotweed (*Polygonum cuspidatum*) has been reported at four sites on the west side of the project reservoirs, including the Baker Lake Highway near Grandy Creek, Sandy and Little Sandy creeks, and Forest Road 1106 near the Upper Baker dam. Giant knotweed (*Polygonum sachalinense*) has been observed at one site along Baker Lake Road. Tansy ragwort (*Senecio jacobaea*) was observed along the Baker Lake Road at Forest Road 1118 (to Horseshoe Cove), near Welker Creek, and at Anderson Point on the east shore of Baker Lake. Common tansy (*Tanacetum vulgare*) was noted near Upper Baker dam and at the south end of Lake Shannon.

The Washington State monitor species watercress (*Rorippa nasturtium-aquaticum*) was observed on Baker Lake southeast of the Upper Baker dam.

Forest Service direction for the management of non-native invasives is currently under development for Region 6. A draft EIS was released in August 2004 and is expected to be finalized in 2005 (Forest Service, 2004b). The most recent, site-specific,

management proposal prepared by the Mt. Baker-Snoqualmie National Forest is the 1999 Forest-Wide Assessment (Forest Service, 1999). A revised site-specific analysis currently is under development for the Mt. Baker-Snoqualmie National Forest and is expected to be released during 2005.

### Wildlife

This section describes the occurrence and distribution of wildlife species in the Pro project vicinity. The Baker River basin supports over 164 species of birds, 60 species of mammals, and numerous additional species of amphibians, reptiles, mollusks, and insects. Puget (2002b) provides lists of the wildlife species that are known or suspected to occur in the habitats of the project vicinity.

The wildlife information in this section is based in part on the results of visual surveys that Puget biologists conducted near the two project reservoirs. Puget conducted monthly wildlife surveys on Baker Lake and Lake Shannon in December through August from 1980 to the present. The surveys were focused primarily on waterfowl, osprey, and bald eagle, but included incidental sightings of other species as well. Data collected during the surveys include species, number, location, sex/age (where possible), and occasional notes on habitat use and behavior (Puget, 2002f; Puget, 2004c). This information has been supplemented by incidental observations of wildlife during other field activities, such as fisheries studies and project maintenance activities. Information about wildlife occurrence in the Baker River basin also was provided by Puget relicensing studies, Forest Service inventories, WDFW reports, and NPS inventories. Written species accounts were prepared for 38 wildlife analysis species selected by the Baker River Terrestrial Resources Working Group (TRWG). The species accounts include the life histories, habitat requirements, distribution, and local occurrence for each analysis species (Hamer Environmental, 2003) and provided much of the information described in this section.

**Reptiles and Amphibians**—Nineteen species of reptiles and amphibians are known or suspected to occur in the project vicinity (Puget, 2002b). Reptiles likely to inhabit the area include the western terrestrial garter snake (*Thamnophis elegans*), common garter snake (*Thamnophis sirtalis*), and northern alligator lizard (*Elgaria coerulea*).

Surveys of amphibian habitats were conducted in 2001 and 2002 for the Baker River Project (Hamer Environmental, 2002a; Hamer Environmental and R2, 2003d). Field survey methods were designed to sample suitable habitats in and near the project area for five species of amphibians with special federal or state management status: Cascades frog (*Rana cascadae*), Oregon spotted frog (*Rana pretiosa*), northern red-legged frog (*Rana aurora*), tailed frog (*Ascaphus truei*), and western toad (*Bufo boreas*). A total of 11 species of amphibians were documented: Pacific giant salamander

(*Dicamptodon tenebrosus*), northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), northern rough-skinned newt (*Taricha granulosa*), western red-backed salamander (*Plethodon vehiculum*), tailed frog, western toad, Pacific chorus frog (*Pseudacris regilla*), northern red-legged frog, Cascades frog, and the non-native bullfrog (*Rana catesbeiana*). The most frequently observed adult amphibians were western toad and northwestern salamander. The Cascades frog was the most numerous juvenile stage observed (9,487 larvae/tadpoles). The bullfrog, which feeds on native amphibians, was observed at only one site, Vogler Lake (over 1 mile from the project area). Oregon spotted frog, a candidate for federal listing, is discussed in detail in section 3.3.6, Federally Listed Threatened and Endangered Species and Essential Fish Habitat.

**Mollusks**—Surveys for mollusks were conducted within 100 feet of the high water mark on Baker Lake during the fall of 2001 and the spring of 2002 (Hamer Environmental, 2002b). The methods followed the Survey Protocol for Terrestrial Mollusk Species from the Northwest Forest Plan, Version 2.0, dated October 29, 1997. During the 73 survey visits, which covered approximately 270 acres, five species of mollusk were confirmed. These included the banana slug (*Ariolimax columbianus*), robust lancetooth (*Haplotrema vancouverensis*), Pacific sideband (*Monadenia fidelis*), Northwest hesperian (*Vespericola columbianus*), and beaded lancetooth (*Anacotrema sportella*). Two slug species were tentatively identified: evening field slug (*Deroceras hesperium*) and warty jumping slug (*Hemphillia glandulosa*). The Forest Service currently designates these two species as sensitive (Forest Service, 2004a).

**Birds**—Over 164 species of birds are known or are potentially present in the Baker River Project Watershed (Puget, 2002b). The species composition includes waterfowl, shorebirds, waterbirds, game birds, raptors, songbirds, and other birds.

The project reservoirs provide habitat for many species of waterfowl. Common species known to breed in the project area include Canada goose (*Branta canadensis*), mallard (*Anas platyrhynhcos*), and common merganser (*Mergus merganser*). Common goldeneye (*Bucephala clangula*), bufflehead (*Bucephala albeola*), American wigeon (*Anas americana*), green-winged teal (*Anas crecca*), and ring-necked duck (*Aythya collaris*) are frequently observed during the winter and spring. The trumpeter swan (*Cygnus buccinator*) is also a regular winter visitor, using Lake Shannon and Baker Lake during November through February.

Shorebirds and waterbirds observed on the project reservoirs include American dipper (*Cinclus mexicanus*), belted kingfisher (*Ceryle alcyon*), and ring-billed gull (*Larus delawarensis*). The great blue heron (*Ardea herodias*) is observed year-round in small numbers. Western grebe (*Aechmophorus occidentalis*) and double-crested cormorant (*Phalacrocorax auritus*) are present primarily in the fall and winter months. Common loons (*Gavia immer*) have been observed in all seasons, but are not known to nest in the

Project area. Marbled murrelets have been observed flying and are suspected to nest within the basin. Information on the federally threatened marbled murrelet is presented in section 3.3.6, Federally Listed Threatened and Endangered Species and Essential Fish Habitat.

The primary species of game bird in the project vicinity is the ruffed grouse, which is found in mixed deciduous/coniferous forest and along secondary roads in forested habitats. White-tailed ptarmigan (*Lagopus leucurus*) are present at high elevations in the basin and band-tailed pigeons (*Columba fasciata*) are found in mature forested areas.

Two raptor species, bald eagle and osprey, are closely associated with the project reservoirs and use several breeding territories along the reservoirs every summer. Bald eagles also are present during the winter in the project area. Golden eagles occasionally use a single nesting territory about 2 miles west of Baker Lake, although they have not been observed in the basin since 1995. Several raptor species use the forests and other upland habitats in the Baker River basin. Northern spotted owl and northern goshawk have been documented in mature and old-growth forests in the upper portion of the Baker River basin. Barred owl (*Strix varia*), great horned owl (*Bubo virginianus*), and western screech owl (*Otus kennicottii*) use forest stands of mixed species composition and age. Other species, such as the red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), and the short-eared owl (*Asio flammeus*), frequent open habitats, meadows and recent clear cuts. The Baker River basin is at the extreme southern edge of the range of the great gray owl (*Strix nebulosa*), which is an occasional visitor during the winter. Peregrine falcon is an uncommon visitor to the basin and is not known to nest in the project vicinity. Refer to section 3.3.6, Federally Listed Threatened and Endangered Species and Essential Fish Habitat, for information on bald eagle and northern spotted owl.

At least 87 species of songbird and other types of birds are known or suspected to use the project vicinity during breeding, wintering, or migration. Species strongly associated with conifer stands include pileated woodpecker, red-breasted sapsucker (*Sphyrapicus ruber*), hairy woodpecker (*Picoides villosus*), varied thrush (*Ixoreus naevius*), chestnut-backed chickadee (*Poecile rufescens*), red-breasted nuthatch (*Sitta canadensis*), winter wren (*Troglodytes troglodytes*), and brown creeper (*Certhia americana*). Open shrub habitats, clear cuts, and meadows provide habitat for birds that forage on the ground, including song sparrow (*Melospiza melodia*) and American robin (*Turdus migratorius*). Aerial insect feeders, such as tree swallows (*Tachycineta bicolor*), violet-green swallows (*Tachycineta thalassina*), and northern rough-winged swallows (*Stelgidopteryx serripennis*), frequent open habitats over land and water. Riparian habitats supporting deciduous trees and shrubs provide habitat suitable for red-eyed vireo, yellow warbler, willow flycatcher, and Swainson's thrush (*Catharus ustulatus*).

**Mammals—**Large mammals in the Baker River Project vicinity include black-tailed deer (*Odocoileus hemionus columbianus*), elk (*Cervus elaphus*), black bear (*Euarctos americanus*), mountain lion (*Felis concolor*), and mountain goat (*Oreamnos americanus*). Both grizzly bear (*Ursus arctos*) and gray wolves (*Canis lupus*) have been observed in the Baker River basin. Canada lynx (*Lynx canadensis*) are present east of the Cascade crest, but are not known to occur in the Baker River basin. Wolverine (*Gulo gulo luteus*) have been documented in the region and may be occasional visitors to the Baker River basin. Refer to section 3.3.6, Federally Listed Threatened and Endangered Species and Essential Fish Habitat, for information on grizzly bear, gray wolf, and Canada lynx.

Furbearer species frequently observed in the project vicinity include river otter (*Enhydra lutra*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), American marten, mink (*Mustela vison*), and coyote (*Canis latrans*). Harbor seals (*Phoca vitulina*) have been observed on occasion in the Lower Baker River (letter from P.A. Sleeger, FWS, Portland, OR, to C. Freeland, Puget, Relicensing Program Manager, Bellevue, WA, dated January 20, 2004).

Common small mammals in the project vicinity are Townsend chipmunk (*Eutamias townsendi*), Trowbridge shrew (*Sorex trowbridgei*), deer mouse (*Peromyscus maniculatus*), snowshoe hare (*Lepus americanus*), Douglas squirrel (*Tamiasciurus douglasi*), and northern flying squirrel (*Glaucomys sabrinus*). One documented sighting of a Townsend's big-eared bat (*Corynorhinus townsendii townsendii*) was recorded in the basin (Perkins, 1988); other bats that may inhabit the vicinity include big brown bat, little brown myotis (*Myotis lucifugus*), long-eared myotis (*Myotis evotis*), silver-haired bat (*Lasionycteris noctivagans*), and Yuma myotis (*Myotis yumanensis*).

### Special Status Wildlife Species

Special status wildlife species known or potentially occurring in the project vicinity are listed in table 3-24. The list includes federal species of concern, Forest Service Region 6 sensitive species (Forest Service, 2004a), Forest Service management indicator species (MIS), WDFW priority species, and Washington State threatened, endangered, candidate, monitor, and sensitive species.

Wildlife species protected under the ESA, including federally listed and proposed species, are discussed in section 3.3.6, Federally Listed Threatened and Endangered Species and Essential Fish Habitat. Candidates for federal listing are also discussed in section 3.3.6.

Table 3-24. Special status wildlife species known or potentially occurring in the Baker River basin.

| Common Name | Scientific Name | Federal Status | State Status | Occurrence in Baker River Basin |
|---|---|---|---|---|
| **Birds** | | | | |
| Black-backed woodpecker | *Picoides arcticus* | Forest Service MIS | Candidate | Potential breeding species; not documented |
| Common loon | *Gavia immer* | Forest Service sensitive | Sensitive | Documented; migrant, non-breeding[a,b,c] |
| Eared grebe | *Podiceps nigricollis* | Forest Service sensitive | -- | Documented; migrant[a] |
| Golden eagle | *Aquila chrysaetos* | -- | Candidate | Documented; breeding territory west of Baker Lake[a] |
| Great blue heron | *Ardea herodias* | -- | Monitor | Documented; breeding species[a,b] |
| Great gray owl | *Strix nebulosa* | -- | Monitor | Documented occasional winter visitor[c] |
| Greater yellowlegs | *Tringa melanoleuca* | Forest Service sensitive | -- | Potential migrant or winter visitor |
| Harlequin duck | *Histrionicus histrionicus* | Species of concern | Priority | Documented; potential breeding species[a] |
| Merlin | *Falco columbaris* | -- | Candidate | Potential winter visitor; not documented |
| Northern goshawk | *Accipiter gentilis* | Species of concern | Candidate | Documented; within 1 mile of project area (March)[a,c,d] |
| Olive-sided flycatcher | *Contopus cooperi* | Species of concern | -- | Potential breeding species |
| Osprey | *Pandion haliaetus* | -- | Monitor | Documented; breeding territories at Baker Lake and Lake Shannon[a] |

| Common Name | Scientific Name | Federal Status | State Status | Occurrence in Baker River Basin |
|---|---|---|---|---|
| Peregrine falcon | *Falco peregrinus* | Species of concern; Forest Service sensitive | Sensitive | Documented; migrant[b] |
| Pileated woodpecker | *Dryocopus pileatus* | Forest Service MIS | Candidate | Documented; resident[a] |
| Vaux's swift | *Chaetura vauxi* | -- | Candidate | Documented; breeding species[a,c] |
| Western grebe | *Aechmophorus occidentalis* | -- | Candidate | Documented; wintering, migrant[a] |
| Wood duck | *Aiz sponsa* | -- | Priority | Documented; potential breeding species[a] |
| **Mammals** | | | | |
| American marten | *Martes americana* | Forest Service MIS | Priority | Resident game species |
| Black-tailed deer | *Odocoileus hemionus columbianus* | Forest Service MIS | Priority | Resident game species |
| Elk | *Cervus elaphus* | Forest Service MIS | Priority | Resident game species |
| California wolverine | *Gulo gulo luteus* | Species of concern; Forest Service sensitive | Candidate | Potential resident; documented sightings at Acme, Sauk River, Cascade Pass[b] |
| Long-eared myotis | *Myotis evotis* | Species of concern | Monitor | Potential resident |
| Long-legged myotis | *Myotis volans* | Species of concern | Monitor | Potential resident |

| Common Name | Scientific Name | Federal Status | State Status | Occurrence in Baker River Basin |
|---|---|---|---|---|
| Mountain goat | *Oreamnos americanus* | Forest Service MIS | Priority | Documented resident game species[b] |
| Pacific Townsend's big-eared bat | *Coryhorhinus townsendii townsendii* | Species of concern; Forest Service sensitive | Candidate | Documented; single individual, Baker Lake basin[e] |
| Western gray squirrel | *Sciurus griseus griseus* | Species of concern | Threatened | Not expected to occur in Baker River basin |
| Yuma myotis | *Myotis yumanensis* | Species of concern | -- | Potential resident |
| **Amphibians** | | | | |
| Cascades frog | *Rana cascadae* | Species of concern | Monitor | Documented; resident[f] |
| Northern red-legged frog | *Rana aurora* | Species of concern | -- | Documented; resident[f] |
| Tailed frog | *Ascaphus truei* | Species of concern | Monitor | Documented; resident[f] |
| Western toad | *Bufo boreas* | Species of concern | Candidate | Documented; resident[f] |
| **Insects** | | | | |
| Beller's ground beetle | *Agonum belleri* | Species of concern | Candidate | Potential resident |
| Hatch's click beetle | *Eanus hatchii* | Species of concern | Candidate | Potential resident |
| Johnson's hairstreak butterfly | *Mitoura johnsonii* | -- | Candidate | Potential resident |

| Common Name | Scientific Name | Federal Status | State Status | Occurrence in Baker River Basin |
|---|---|---|---|---|
| **Mollusks** | | | | |
| Evening field slug | *Deroceras hesperium* | Forest Service Sensitive | -- | Unverified observation[g] |
| Warty jumping slug | *Hemphillia glandulosa* | Forest Service Sensitive | -- | Unverified observation[g] |

Notes:
**Federal Status:**
Species of concern–Species for which the FWS does not have sufficient information to support a listing proposal at this time.
Forest Service sensitive–Species listed by the Regional Forester.
Forest Service MIS–Species that are believed to be representative of a larger group of wildlife species with similar habitat needs.
**State Status:**
Endangered–Any taxon in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue.
Threatened–Any taxon likely to become endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation continue.
Sensitive–Any taxon that is vulnerable or declining and could become endangered or threatened in the state without active management or removal of threats.
Candidate (animals)–Taxa under review for listing.
Monitor (animals)–Taxa requiring management, survey, or data emphasis.
Priority (animals)–Fish and wildlife species requiring protective measures and/or management guidelines to ensure their perpetuation.
[a] Puget (2002f).
[b] Forest Service (2002a).
[c] WDFW (2004).
[d] FWS (2004a).
[e] Perkins (1988).
[f] Hamer Environmental and R2 (2003d).
[g] Hamer Environmental (2002b).

### Birds

**Black-backed Woodpecker—**The black-backed woodpecker (*Picoides arcticus*) is an uncommon species of mountainous coniferous forests and open coniferous forests of northern North America. Its preferred habitat is among spruce, fir, lodgepole pine, and/or ponderosa pine, with adequate snags. Black-backed woodpecker may nest at higher elevations of the Baker Lake basin and may be an occasional visitor to the project area

during irruptive events. Black-backed woodpecker is a Washington State candidate species and a Forest Service MIS.

**Common Loon**—Common loon is a Washington State sensitive species and a Forest Service Regional Forester's sensitive species. Breeding pairs are known from a limited number of locations in Washington. Habitat loss and susceptibility to disturbance and predation are the primary factors thought to be responsible for low numbers of breeding pairs. Adult loons are commonly observed on the project reservoirs during the winter, spring, and summer. However, nesting loons have never been observed in the project area (Hamer Environmental, 2003; Puget, 2002f).

**Eared Grebe**—Eared grebe (*Podiceps nigricollis*) is a Forest Service sensitive species that has been documented on the project reservoirs on several occasions during the winter and spring. In Washington, colonies of breeding eared grebes are found primarily in freshwater lakes in the eastern portion of the state (Wahl and Paulson, 1981).

**Golden Eagle**—Golden eagles are opportunistic predators and scavengers of open habitats and forested mountain terrain. In Washington, golden eagle is a state candidate species. A golden eagle breeding territory is located about a mile west of Baker Lake. The territory has been used intermittently over the period of survey by Puget (1980–2002); the last verified use was in 1995, with one chick observed in the nest during July (Puget, 2002f). The site has been inactive over the past 7 years and is possibly abandoned. The WDFW database reports the existence of two other nest sites in or near the basin: in the upper Thunder Creek and Jackman Creek drainages.

**Great Blue Heron—**Great blue heron is a WDFW monitor species. Small numbers of herons are regularly observed along the shorelines of the project reservoirs (Puget, 2002f). No breeding colonies had been documented in the Baker River basin prior to 2003 per the WDFW priority and habitats species database (WDFW, 2003b). However, during a 2003 Puget aerial survey of raptor nests, a heronry was observed within the project area to the west of the Upper Baker Development; this heronry was active again in 2004, with eight chicks observed.

**Great Gray Owl—**Great gray owl is a WDFW monitor species. This large owl inhabits northern boreal forests, occasionally ranging into northern Washington and Idaho during the winter. One observation of a great gray owl has been recorded south of the Baker River basin (WDFW, 2004); the owl was observed in the Jackman Creek drainage.

**Greater Yellowlegs—**Greater yellowlegs (*Tringa melanoleuca*) is a large species of sandpiper that nests in northern muskegs and winters in coastal wetlands. The Forest Service considers the species to be sensitive. No observations of greater yellowlegs have been recorded in the WDFW database for the Baker River basin (WDFW, 2004).

**Harlequin Duck**—Harlequin duck is a FWS species of concern and a WDFW priority species. During the breeding season, April to June, harlequin ducks use forested and dense shrub cover along rapidly flowing streams. Harlequin ducks winter primarily along the Strait of Georgia. Harlequin ducks have been observed on the project reservoirs (Puget, 2002f). The Baker River upstream of the project may provide suitable breeding habitat for this species.

**Merlin**—The merlin (*Falco columbarius*) is a Washington State candidate species. These falcons inhabit open habitats, including open woodlands and savannah. Merlin may occasionally pass through the Baker River basin during migration.

**Northern Goshawk**—The northern goshawk is a federal species of concern and a state candidate species. Goshawks inhabit mature to old-growth coniferous and mixed forests and open woodlands. A few sightings of adult and young goshawks have been reported in the Baker River basin (WDFW, 2004), including one observation on March 23, 1993, near the Baker Lake reservoir (Puget, 2002f).

**Olive-sided Flycatcher**—The olive-sided flycatcher is a FWS species of concern. These insectivorous birds typically nest along forest edges and openings, in areas where there are tall trees and snags for singing and foraging perches (Hamer Environmental, 2003). Coniferous trees are often used for nesting, with nests located high in the tree and away from the trunk. The reasons for recent decline in the species population are unknown, but are suspected to be related to habitat loss in wintering areas. This species may use the reservoir edges or other openings in the project vicinity.

**Osprey**—Osprey is a Washington State monitor species. These migratory raptors nest adjacent to rivers, lakes, and saltwater in western Washington, feeding almost exclusively on fish. The project reservoirs provide high-quality habitat for breeding osprey, typically supporting five or more pairs each year on each reservoir. Puget has conducted monthly surveys of the reservoirs between December and August since 1980 and has recorded nest occupancy and number of chicks each breeding season.

Baker Lake has approximately 10 natural osprey nesting territories. Each territory is not used every year, and many of the territories have multiple alternate nest sites. Between 1994 and 2004, an average of eight osprey nests have been occupied at Baker Lake during the July survey (Puget, 2002f; Puget, 2004c).

During the 1980s, Lake Shannon had several natural nest sites located on large snags created by the inundation of the reservoir. Over time, the snags deteriorated and ospreys were forced to nest on short snags and stumps vulnerable both to harassment by boaters and to flooding by the fluctuating reservoir. Few natural snags were available adjacent to Lake Shannon due to timber management; therefore, Puget replaced

deteriorated nest snags with pole-mounted artificial nest structures. Currently, three natural sites and nine artificial nesting structures are present in Lake Shannon. An average of seven osprey nests have been occupied at Lake Shannon during July of the last 11 years (Puget, 2002f; Puget, 2004c).

Production at the osprey nests is difficult to assess because of inaccuracies in chick counts performed from below the nests during boat surveys and the fact that fledgling osprey are nearly indistinguishable from adults. An average of seven and eight chicks were observed during July in the Baker Lake and Lake Shannon nests, respectively, over the last 11 years (Puget, 2002f; Puget, 2004c). Given that osprey are long-lived, production at the project area nests is believed to exceed that necessary to sustain the local population.

**Peregrine Falcon**—Formerly classified as federally endangered, the American peregrine falcon was delisted in August 1999. The species was greatly affected by DDT and other organochlorine pesticides that accumulated in their prey; however, populations have rebounded in the past 20 years and the species is now well-distributed in Washington State (Hayes and Buchanan, 2002). The WDFW downlisted peregrine falcon from state endangered to state sensitive in 2002 (WDFW, 2002b). No peregrine falcon nest sites are known from the Baker River Project vicinity, and annual surveys of the project area during bald eagle and osprey nesting have not detected peregrine falcons. Use of the project vicinity is likely limited to occasional migratory falcons. One observation of a peregrine falcon was reported from the Baker River drainage in April 1985 (Forest Service, 2002a).

**Pileated Woodpecker**—Pileated woodpecker is a Washington State candidate species and a Forest Service MIS. These woodpeckers are closely associated with mature and old-growth forests, using large diameter snags for nesting and roosting (Hamer Environmental, 2003). The late- and old-successional forests in the Baker Lake and Baker River basin provide high-quality habitat for pileated woodpecker. Because of the extent of timber harvest activity near Lake Shannon, suitable habitat at this reservoir is restricted to occasional, typically small, stands of mature or old-growth forest.

**Vaux's Swift**—This species is a candidate for listing in the state of Washington. It inhabits coniferous and mixed coniferous/deciduous forests, typically selecting large diameter, hollow trees or woodpecker holes as nesting and roost sites. It is also known to occasionally nest in chimneys. Foraging occurs above the forest canopy, in forest openings, and over water. Mature and old-growth coniferous and mixed forest stands in the project vicinity provide suitable habitat for Vaux's swift. Vaux's swifts have been observed during surveys of the project reservoirs (Puget, 2002f). An active Vaux's swift nest site was reported in the Sandy Creek drainage in 1991 (WDFW, 2004).

**Western Grebe**—The western grebe (*Aechmophoris occidentalis*) is a candidate for listing in the State of Washington. This water bird has been observed occasionally at the project reservoirs, primarily during the fall, winter, and spring. Suitable nesting habitat for western grebe requires emergent wetland vegetation, such as tule or reeds, which are not present at the project reservoirs.

**Wood Duck—**Wood duck (*Aix sponsa*) is a WDFW priority species. Wood ducks have been observed at Lake Shannon (Puget, 2002f) and may breed in the Baker River basin.

**Mammals**

**American Marten—**American marten is a WDFW priority species and a Forest Service MIS. Marten is a resident game species in the Baker River basin, and is closely associated with late successional and old-growth forests.

**Black-tailed Deer**—Black-tailed deer is an important game species in Washington State and is a Forest Service MIS. Game Management Unit (GMU) 418 Nooksack extends from the Skagit River north to the Canadian border and from west of the North Cascades National Park to Highway 9. Harvest data for GMU 418 indicate a total of 174 deer harvested in 2001 and 107 in 2002 (WDFW, 2001a, 2002c). The current population objective for GMU 418 and nearby GMUs 407, 410, 426, 437, and 450, is to maintain a post-hunt ratio of 15 bucks to 100 does, when possible (WDFW, 2001b). Black-tailed deer harvest in these GMUs totaled 1,193 animals and comprised 2.9 percent of the total statewide harvest for the 2001 season; harvest in these GMUs totaled 1,151 animals and 3.0 percent of total statewide harvest for the 2002 season.

The extensive forested habitats of the Baker River basin do not provide optimal deer habitat, and deer were not likely historically abundant. Openings created by natural disturbances and logging can temporarily increase the quality of forage habitat. Black-tailed deer are present in the Baker River basin and are most commonly observed in the lower elevation, managed timberlands surrounding Lake Shannon, where forage is more abundant.

**Elk**—Elk is an important game species, a WDFW priority species, and a Forest Service MIS. The North Cascade elk herd, also referred to as the Nooksack herd, is described in detail in a recent WDFW elk herd management plan (Davison, 2002). The Nooksack herd is the smallest of 10 herds in the State of Washington. It is considered to be a reintroduced population of Rocky Mountain elk (*C. elaphus nelsoni*) released in 1912 and 1948 and Roosevelt elk (*C. elaphus rooseveltii*) released in 1946. The range of the Nooksack herd includes portions of Whatcom, Skagit, Snohomish, and King counties between the Skykomish River and the Canadian border and from the Cascade crest west to Highway 9. The core area for this herd occupies about 492 square miles and extends

from the western side of the Baker River watershed to just east of Highway 9 north of Highway 20.

The population in the Nooksack GMU decreased from an estimated 1,700 animals in 1984 to 300 animals in 2000. The population objective for the Nooksack GMU is 1,450 animals. In the North Cascades, mortality rates between 1993 and 2000 have been reduced by: (1) severely restricted hunting seasons (closed since 1993), (2) extensive road access restrictions, and (3) reduced hunter effort.

Suitable habitat for elk in the Baker River basin includes both mid- to high-elevation summer range and lower-elevation transitional and winter range. Farrow (1995) described the locations and seasonal use of these ranges in the Baker Lake vicinity using information collected from two radio-collared elk. Summer range for both radio-collared cows was located in the mid- to upper elevations of Sandy and Dillard creeks; use of the summer range extended from mid-May to late October. Transition range included low elevation habitat along the west side of Baker Lake, including the lower reaches of Boulder, Park, and Little Sandy creeks, and possibly including lower Rocky Creek and 1799 hill. Elk migrated from the transition areas to low elevation winter range along the Skagit River between September and December. During mild winters, transition range was used throughout much of the winter. Spring migration occurred between early April and early May, and the elk used lower Vogler Lake, Bear, Rocky, Sulphur, and lower Sandy creeks, and 1799 hill as transitional habitat. Farrow (1995) noted that pellet count data also indicated spring transition use of lower Boulder and Park creeks. Farrow concluded that transition range along the west side of Baker Lake may be used between early September and late May, depending on the severity of the winter.

An elk habitat mapping study (EDAW and University of Illinois, 2003) was conducted as part of project relicensing. The study provides site-specific information and modeling of elk habitat quality and uses existing radiotelemetry data to identify areas most often used by elk in the project vicinity. The study area was divided into three elk ranges based on elevation and radio-telemetry data. Summer range is located above 2,400 feet elevation, and is used primarily July through September (57 percent of study area). Spring/fall transition range is restricted to the mid-elevation habitat between Swift Creek to Rocky Creek (12 percent of study area). Winter/transitional range is the lowest elevation zone and extends from Swift Creek to Highway 20 (31 percent of study area).

Approximately 29 percent of the study area supports good quality elk forage; almost two-thirds of this is located in high elevation summer range areas. A total of 42 percent of the study area exhibits poor quality elk forage habitat, including substantial portions of the summer and winter/transitional ranges. Seventeen percent of the study area supports marginal forage habitat. The study also evaluated roads and recreation sites that could contribute to human disturbance of elk, providing information that can be used in developing mitigation and enhancement measures such as road closures.

**California Wolverine**—Wolverine is a FWS species of concern, a Forest Service sensitive species, and a candidate for listing in Washington State. Suitable habitat for wolverine, open, high-elevation forests and alpine zones, is present in the upper reaches of the Baker River basin. No wolverine have been recorded in the basin; the nearest verified sighting was in the town of Acme in the late 1990s (Forest Service, 2002a).

**Long-eared Myotis**—The long-eared myotis is a federal species of concern and a Washington State monitor species. This species is strongly associated with forested habitats and forest edges, including Douglas fir, true fir, spruce, and subalpine forests. It also uses deciduous shrubs and forests of riparian zones. Suitable habitat for long-eared myotis may be present in the project vicinity. The Forest Service did not detect long-eared myotis during its bat survey of areas within the Mt. Baker Ranger District (Perkins, 1988).

**Long-legged Myotis**—The long-legged myotis (*Myotis volans*) is a federal species of concern and a state monitor species. This species is closely associated with coniferous forests and uses cliff crevices, caves, and abandoned buildings for roosting. Suitable habitat for long-legged myotis may be present in the project vicinity. The Forest Service did not detect the long-legged myotis during its 1988 bat survey of areas within the Mt. Baker Ranger District (Perkins, 1988).

**Mountain Goat**—Mountain goat is an important native game species in Washington, a WDFW priority species, and a Forest Service MIS. The Baker River basin provides suitable year-round habitat for the species. A population survey of the Mt. Baker hunting area in 1960 estimated a population size of 650 goats (Johnson, 1977). A 1995 aerial survey of the Mt. Baker area resulted in a population estimate of between 59 and 212 mountain goats (Forest Service, 2002a). As a result of this low population estimate, the Mt. Baker area was closed to sport hunting in 1995. The most recent aerial survey was performed in 2001 and resulted in a population estimate of 183 to 484 goats (Forest Service, 2002a).

**Pacific Townsend's Big-eared Bat**—The Pacific subspecies of Townsend's big-eared bat is a federal species of concern, a Forest Service sensitive species, and a state candidate for listing. The species is an insectivore that inhabits forested regions primarily west of the Cascade Mountains. Townsend's big-eared bats are primarily cavity-dwellers, typically selecting roost sites in caves or abandoned mines; they also use human-made structures such as barns, attics, and bridges, as long as human disturbance is very low. They require different sites with specific microclimatic conditions for roosting, hibernation, and reproduction. Caves have reportedly been used as maternal roost sites and hibernacula; bridges have also been documented as maternal sites.

Suitable habitat for Townsend's big-eared bat foraging is present in the project vicinity. The Forest Service conducted a bat survey of portions of the Mt. Baker Ranger District and detected a single Pacific Townsend's big-eared bat (Perkins, 1988). Perkins speculated that the hibernacula may be located along Chuckanut Creek, west of the project vicinity. Limestone formations are present near the Lower Baker dam, and caves in these formations could potentially be suitable sites for big-eared bat hibernacula.

**Western Gray Squirrel**—The western gray squirrel (*Sciurus griseus griseus*) is a federal species of concern and a state threatened species. The distribution of western gray squirrel in Washington includes the Puget Trough ecoregion from Pierce County southward, and scattered locations east of the Cascades from Okanogan County to Klickitat County.[26] The species is closely associated with mature oak-pine and oak-fir forests, and is intolerant of urbanization and traffic. The WDFW Priority Species and Habitats database shows no records for western gray squirrel in the Baker River basin (WDFW, 2004).

**Yuma Myotis**—This bat species is closely associated with water and typically forages for insects close to the surface of open water bodies. It is associated with a wide variety of habitats, ranging from forest stands to dry, open shrub communities. Yuma myotis roosts in caves, mines, and human-made structures, such as sheds, barns, and bridges. They are susceptible to human disturbance, but may be locally abundant where suitable roosting habitat is present. The Forest Service did not detect the Yuma myotis during its bat survey of portions of the Mt. Baker Ranger District (Perkins, 1988).

**Amphibians**

**Cascades Frog**—The Cascades frog is a federal species of concern and a state monitor species. In Washington, the Cascades frog occurs at mid- to high elevations in the Cascades and the Olympic mountains (Leonard et al., 1993). The species is most commonly found in small pools in subalpine meadows and also inhabits sphagnum bogs, forested swamps, small lakes, ponds, and marshes near streams.

Amphibian surveys in the project area resulted in detections of Cascades frog adults or tadpoles at 29 sites (Hamer Environmental, 2002a; Hamer Environmental and R2, 2003d). All but three of the sites were permanent lakes or ponds, and the majority of detection sites were in or near forested habitats dominated by red alder.

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[26] The Puget Trough ecoregion embraces the lowlands and marine waters lying between the Cascades on the east and the coastal ranges on the west, from sea level to an elevation of about 1,000 feet, as well as the Strait of Juan de Fuca coastal plain west to the Twin Rivers mouth and the western end of the Columbia Gorge upriver of southwestern British Columbia and south through Oregon's Willamette Valley.

**Northern Red-legged Frog**—The northern red-legged frog is a federal species of concern that occurs at low to moderately high elevations in western Washington. It typically uses small ponds, pools, and swamps within forest stands. During the breeding season, the species is most abundant in ponds and pools that are seasonally, rather than permanently, flooded. Red-legged frogs breed in winter, attaching the egg masses weakly to emergent vegetation or underwater branches. Newly metamorphosed frogs, as well as mature adults, are more terrestrial than aquatic, inhabiting shrub and forested areas near permanent water.

Amphibian habitats were surveyed in the Baker River Project area in 2001 and 2002 (Hamer Environmental, 2002a; Hamer Environmental and R2, 2003d). Northern red-legged frogs were among the most frequently observed species in the project area during the surveys and were recorded at eight aquatic sites including both stream and reservoir areas. All sites had a silt/mud substrate, and emergent vegetation, primarily reed canarygrass, covered over 50 percent of the sites' margins.

**Tailed Frog**—The tailed frog is a federal species of concern and a state monitor species that occurs in cold, rocky streams from British Columbia to northern California. Tailed frogs inhabit streams from low to high elevation, spending several years as tadpoles. Adults are nocturnal and infrequently seen, emerging at night to feed on insects near the stream and in the adjacent forest. Adults can be found in summer, and tadpoles year-round, by turning over rocks in the stream.

Project area amphibian surveys (Hamer Environmental and R2, 2003d) detected the presence of tailed frogs at three sites, each of which was a natural, permanent stream with a silt/gravel, cobble and boulder/bedrock substrate. These sites had no emergent vegetation and were all located within the forest.

**Western Toad**—The western toad is a federal species of concern and a Washington State candidate for listing. In Washington, western toad is found in all but the driest portions of the Columbia River basin (Leonard et al., 1993). The species has become uncommon in western Washington lowlands and in the mountain meadows of the North Cascades, possibly due to habitat alteration. Western toads are pond breeders and use marshes and small lakes from low to high elevations. They also travel cross-country for long distances, crawling and climbing through dry forests and thickets. Outside of the breeding season, western toads are nocturnal, emerging at night from refuges, including soil excavations, burrows of other animals, and hollows beneath woody material. Western toad tadpoles are gregarious, forming large schools. Newly metamorphosed toadlets are often observed in large numbers on forest floors or crossing roads.

Amphibian surveys performed in the project area detected western toad at 27 different sites, primarily along the shores of Baker Lake (Hamer Environmental and R2, 2003d). No egg masses were detected during the surveys. Baker River Project personnel

also reported that large congregations of toadlets were often seen along the shoreline of Baker Lake during the late summer.

### Insects

**Beller's Ground Beetle**—Beller's ground beetle (*Agonum belleri*) is a federal species of concern and a state candidate for listing. It is a flightless beetle found in sphagnum bogs from southwestern British Columbia to northern Oregon. Beller's ground beetle has been reported in western Washington at sites from eastern Puget Sound to the Cascades. It typically is found in bogs among floating mats of sphagnum. Little is known about the population status of the species. One study in King County, Washington, estimated the population density of Beller's ground beetle at 15 adults per square meter (Larson et al., 1995).

One sphagnum bog wetland has been recorded in the project area along the western shore of Baker Lake (wetland number WB-30; Hamer Environmental et al., 2004). This wetland may provide suitable habitat for Beller's ground beetle.

**Hatch's Click Beetle**—Hatch's click beetle (*Eanus hatchii*) is a federal species of concern and a state candidate species. The species inhabits lowland sphagnum bogs of northwest Washington and is associated with low, floating mats dominated by sphagnum. Little is known about the population of the species, but it is believed to have been reduced through habitat loss and alteration (Larsen et al., 1995).

Sphagnum bog wetland number WB-30, located on the western shore of Baker Lake, may provide suitable habitat for Hatch's click beetle.

**Johnson's Hairstreak Butterfly**—Johnson's hairstreak butterfly is a candidate for listing in the State of Washington. This is a rare species of butterfly known from southwestern British Columbia to central California, almost exclusively west of the Cascade and Sierra Nevada mountains (Hamer Environmental, 2003). Its larvae feed on dwarf mistletoe (*Arceuthobium* spp.); consequently, the butterfly is found only in or near Douglas fir and western hemlock stands that are infected with mistletoe. Adult butterflies feed on nectar of mistletoe and understory plants. Forest industry prescriptions to eradicate mistletoe and the spraying of *Bacillus thuringiensi* to eliminate introduced gypsy moth have affected Johnson's hairstreak.

Hemlock dwarf mistletoe (*Arceuthobium tsugense*) occurs commonly in western hemlock in the Baker River watershed (Forest Service, 2002a). Mountain hemlock dwarf mistletoe (*Arceuthobium tsugense* spp. *mertensiana*) was formerly designated as a survey and manage species under the Northwest Forest Plan and may occur in the basin. Suitable habitat for Johnson's hairstreak likely occurs throughout the watershed within mature and old-growth conifer stands exhibiting mistletoe infections.

### Mollusks

**Evening Field Slug**—The evening field slug is a Forest Service sensitive species and a state monitor species. In Washington, the evening field slug inhabits low- to mid-elevation sites from the Cascades to the Pacific Ocean. The species is associated with litter, debris, rock crevices, and various types of low vegetation.

**Warty Jumping Slug**—The warty jumping slug is a Forest Service sensitive species and a state monitor species. The range of the warty jumping slug in Washington extends from the western Cascades to the Pacific coast. The species prefers moist coniferous forests and is associated with conifer logs and heavy ground cover of low vegetation, litter, and debris.

Surveys for mollusks were conducted over 73 survey visits covering approximately 270 acres of potential habitat in the project area (Hamer Environmental, 2002b). One sighting of a mollusk suspected to be a warty jumping slug was recorded; the species identification was not verified.

### 3.3.5.2 Environmental Effects

### Reservoir Level Management

Current Operations and the Proposed Action are described in section 2.0, Proposed Action and Alternatives. Section 3.3.2.2, Water Quantity, Environmental Effects, provides a detailed discussion of the effects of Current Operations and the Proposed Action on reservoir elevations and management.

Current Operations of the Baker River Project result in fluctuation of the water surface levels in both project reservoirs. Reservoir fluctuations have the potential to affect a number of terrestrial resources, including amphibian breeding habitat and in-reservoir snags which may support cavity-nesting birds or osprey nests. Water-level fluctuations may also influence the ability of certain species to breed in the project area. Common loons are frequently observed on the project reservoirs but may be precluded from nesting in part due to reservoir fluctuations. Changing water levels and the occurrence of weedy plant species along portions of the reservoir shorelines may influence the plant communities surrounding the reservoirs. Continued operation of the reservoirs would result in continued potential for erosion along the reservoir shorelines and within the reservoirs.

The Proposed Action includes two measures that would influence reservoir water levels: Proposed Article 106, Flow Implementation, and Proposed Article 401, Water Quality. The proposed flow implementation article is based on consideration of multiple factors including aquatic, recreation, terrestrial, and cultural resource needs; human

health and safety; flood control; and project economics. Proposed Article 106 specifies operation parameters for the interim period prior to construction of two new 750-cfs turbine-generating units at Lower Baker, and presents the proposed target maximum and minimum reservoir levels to be achieved after installation of the new generating units. Proposed Article 106 also describes the components of a FIP, including monitoring and reporting of flows and ramping rates and allowable temporary modifications to flows and ramping rates for natural events and emergencies. Proposed Article 401 restricts drafting the reservoirs below certain elevations to limit the likelihood of resuspending fine sediments.

*Effects Analysis*

We base our analysis of reservoir water levels on modeling of project operations for 5 representative years using the HYDROPS model (refer to section 3.3.2.2, Water Quantity, Environmental Effects). Operation of the project under the Proposed Action is expected to result in a more consistent overall rate of fall drawdown at Baker Lake compared to Current Operations. The fall drawdown would occur gradually during the September to December period, rather than almost entirely during the month of September as currently occurs. Water levels would generally be within three feet of full pool under both the Proposed Action and Current Operations during June through August. At Lake Shannon, the Proposed Action would result in October through February water levels typically higher than under Current Operations. Water levels during April and May would be more variable under the Proposed Action than under Current Operations, but would not be expected to have a different or more adverse effect.

The Proposed Action would not change the general pattern of seasonal reservoir levels, which historically has consisted of average low water surface elevations during the winter and average high water surface elevations during the late spring and summer. Wetlands along the reservoir shoreline dependent upon the reservoirs for part or all of their hydrology, would experience the same range of variation as under Current Operations. Implementation of the Proposed Action is not expected to change the characteristics of plant communities surrounding the reservoirs relative to the current condition.

Relative to Current Operations, the Proposed Action would result in gradual exposure of fluctuation zone habitats in Baker Lake from September to December, rather than almost entirely during the month of September. This change could alter the growth and distribution of reed canarygrass along project shorelines. Actual growth expansion of reed canarygrass during the fall is dependent upon a large number of variables, including slope, aspect, current vegetation conditions, wave action, annual variation in rainfall, insolation, and temperature. Implementation of the Proposed Action would not be expected to cause substantial change in the characteristics of within-reservoir plant

communities relative to current conditions. Some slight shifts in the distribution of reed canarygrass could occur.

**Project Releases**

Project releases under Current Operations and the Proposed Action are described in section 2.0, Proposed Action and Alternatives. The effects of the proposals are evaluated in section 3.3.2.2, Water Quantity, Environmental Effects.

The Lower Baker River extends 1.2 miles from the Lower Baker dam to its confluence with the Skagit River. Between the dam and the powerhouse (RM 0.9), the river is located in a narrow, bedrock-controlled canyon. Between the powerhouse and the barrier dam (RM 0.6), the river is narrow and confined by steep sideslopes. From the barrier dam to the Skagit River, the Baker River is dominated by hardened streambanks and a confined channel.

Flow in the dam to powerhouse reach is limited to about 80 cfs which is provided to the Lower Baker River for operation of the adult fish trap-and-haul facility. Of this total, approximately 55 cfs consists of leakage through the dam and 25 cfs is routed through a bypass valve. During spill events, greater amounts of water enter the lower river. Daily load-following operations can cause flows in the Lower Baker River downstream of the powerhouse to fluctuate up to 4,200 cfs within several hours.

Under the Proposed Action, Puget would implement a new flow regime (Proposed Article 106) once the two new 750-cfs turbine-generating units are installed at the Lower Baker Development. This measure would provide: (1) a minimum year-round instream flow of 1,000 to 1,200 cfs, depending on the time of year, as measured at the Baker River at Concrete gage; (2) maximum instream flows at the Baker River at Concrete gage of 3,200 to 5,600 cfs, depending on the time of year, except when inflow to Baker Lake or Skagit River flows are high during October through December; (3) a schedule of ramping rates for all licensee-controlled streamflow releases from the Lower Baker Development; and (4) specific protocols for monitoring, evaluating compliance and reporting.

*Effects Analysis*

**Lower Baker River—**There is little potential for riparian vegetation to develop or persist in the narrow, confined reaches of the Lower Baker River as the majority of the shoreline is unvegetated bedrock, steep rocky slopes, or hardened streambank.

Implementation of the Proposed Action would result in substantially higher typical low flows in the Lower Baker River than provided by Current Operations. Lower Baker River 90 percent exceedance flows would be increased from 80 cfs to 1,000 cfs or more during all months of the year (figure 3-5), based on HYDROPS modeling of five selected representative years (refer to section 3.3.2.2, Water Quantity, Environmental Effects).

Under the Proposed Action, the largest changes in monthly average hourly flows (figure 3-6) compared to Current Operations would be reduced Baker River flows in April and September, and increased Baker River flows in October.

Evaluation of 10 percent exceedance flows (figure 3-6) shows that implementation of the Proposed Operations would reduce March high flows from about 4,000 cfs to 1,200 cfs (70 percent), and increase November flows from a range of about 4,000 to 4,400 cfs up to a range of about 5,400 to 5,600 cfs (26 to 33 percent).

Increased flows during the low water season in the lower river could provide the potential for riparian vegetation to develop on any portions of the streambank exhibiting substrate suitable for plant growth. Factors influencing riparian vegetation establishment in this reach include substrate, slope, aspect, and scouring effects of high flows. No substantial development of riparian vegetation would be expected to occur under either scenario, due to the lack of suitable substrate and the continued occurrence of scouring high flows.

**Skagit River—**As modeled for the Proposed Action, 90 percent exceedance flow values (low flows) for the Skagit River would increase somewhat throughout most of the year. The 90 percent exceedance flow for April would be reduced by 1,380 cfs, or 15 percent (figure 3-5).

The Proposed Action would modify average hourly flows in the Skagit River below Concrete only slightly (5 percent or less) in comparison to overall flow levels (figure 3-6).

Based on analysis of HYDROPS hourly flow modeling, the 10 percent exceedance flow values (high flows) under the Proposed Action would be similar to those observed under Current Operations in the Skagit River (figure 3-7).

HYDROPS modeling of the Proposed Action for the 5 representative years indicates that daily flow fluctuations in the Skagit River would be reduced by 500 cfs or more 38 percent of the time.

Implementation of the Proposed Action would result in slightly increased low-flows throughout most of the year and would contribute to reduction of daily flow fluctuations. This operation scenario is not expected to adversely affect riparian vegetation along the Skagit River below Concrete.

Proposed Article 505 would require Puget to develop an Aquatic Riparian Habitat Protection, Restoration and Enhancement Plan. Under this plan, Puget would acquire, protect and enhance low-elevation bottomland ecosystems in the Skagit River basin

focusing on habitat for anadromous salmonids, other aquatic species and riparian-dependent birds and amphibians.

However, Proposed Article 505 does not include enough detail to allow us to assess the potential benefits of the specific measures that would be implemented by the plan, or the nexus of those measures to project impacts. It is unclear exactly what type of habitat would be acquired under this article; how many acres would be acquired; and what management actions would be taken (if any) on acquired lands. Also, it is likely most land acquisitions would be outside project boundaries given the geographic preferences stated in the proposed article. Given the lack of specifics, we cannot evaluate the benefits of the proposed article. The type of additional information we would need to evaluate this article would include: estimated number of acres of land to be acquired and/or enhanced; the location of these lands relative to existing project boundaries; any proposed changes to existing project boundaries associated with land acquisitions; the specific enhancement and/or management activities that would occur on these lands once acquired; the benefits associated with these measures; nexus to project effects and/or resources; and any ongoing, long-term operation and maintenance responsibilities. We make our final recommendation regarding Proposed Article 505 in section 5.1, Comprehensive Development and Recommended Alternative.

**Plant Communities and Wildlife Habitats**

**Deciduous Forest Habitat—**Current project operation has minor effects on existing deciduous forest habitats through the influence of fluctuating reservoir water levels. Erosion occurs along portions of the reservoir shorelines under current conditions, and can result in disturbance and loss of shoreline vegetation. Continued operation of the project reservoirs precludes the development of deciduous forest habitats (T7-B Study; Biota Pacific and R2, 2003). Deciduous forest habitat is in short supply in the Baker River basin, lowland Skagit River basin, and the Puget Sound lowlands and valleys. Deciduous woodland habitat is identified as an important component of riparian habitat, a conservation priority in the *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman, 2000).

Under the Proposed Action, a new auxiliary powerhouse would be constructed on the original powerhouse site at the Lower Baker Development. Approximately 1 acre of young deciduous riparian habitat would be permanently cleared during construction of this facility. Several measures proposed for the enhancement of fish resources also have the potential to result in disturbance and/or clearing of deciduous vegetation, including fish propagation facilities (Proposed Article 101), downstream fish passage facilities at both the Upper and Lower Baker developments (Proposed Article 105), and fishway connectivity facilities between Lake Shannon and Baker Lake (Proposed Article 104). In total, these developments are expected to result in the disturbance of approximately 19 acres; only a small portion of this total would be deciduous forest habitat.

Under the Proposed Action, a habitat management measure (Proposed Article 502) would provide for certain acquisition and management of deciduous forest habitat. Qualifying habitat would comprise land with 40 percent or greater deciduous tree composition. This habitat would benefit deciduous forest dwelling species, including neotropical migratory birds. The specific parcels and enhancement actions would be determined in consultation with the TRIG.

The Proposed Action also includes a measure to develop and implement an Erosion Control Plan, in consultation with the Forest Service (Proposed Article 110). This plan would include identification of sites with specific resource concerns and development, implementation, and monitoring of erosion control treatment methods. This measure could be used to protect specific high-value deciduous forest sites along the reservoir margins.

*Effects Analysis*

Proposed Article 502, Forest Habitat, would provide for protection and enhancement of a substantial number of acres of deciduous forest habitat to benefit deciduous forest-dwelling species. The number of acres to be managed would substantially exceed the number of acres to be affected by the new auxiliary powerhouse at the Lower Baker Development and fisheries enhancement facilities. This measure would also offset any losses of deciduous forest habitat along the reservoir shorelines due to erosion. However, we note that this proposed article does not identify the number of acres to be enhanced or acquired or any management actions that would be taken on these lands once acquired. We make our final recommendation regarding Proposed Article 502 in section 5.1, Comprehensive Development and Recommended Alternative.

**Late Seral Forest Habitat—** Current project operation has minor effects on existing late seral forest habitats through the influence of fluctuating reservoir water levels. Erosion occurs along portions of the reservoir shorelines under current conditions (refer to section 3.3.1.1), and can result in disturbance and loss of shoreline vegetation. The habitat edge created along the interface of the reservoir shoreline and late-seral forest may increase the risk of predation for mature and old-growth dependent species such as marbled murrelet and northern spotted owl.

Under the Proposed Action, vegetation clearing associated with the new auxiliary powerhouse on the site of the original powerhouse at the Lower Baker Development would not be expected to affect late seral forest habitats (refer to Secondary Effects discussion in section 3.3.5.2, Terrestrial Resources, Affected Environment). Several measures proposed for the enhancement of fish resources also would not be expected to result in disturbance and/or clearing of forest vegetation, including fish propagation facilities (Proposed Article 101), downstream fish passage facilities at both the Upper and

Lower Baker developments (Proposed Article 105), and fishway connectivity facilities between Lake Shannon and Baker Lake (Proposed Article 104). Preliminary siting information for these proposed developments indicates that the majority of these facilities would be constructed in areas dominated by previous disturbance, young seral vegetation, and/or reservoir drawdown zones. No clearing of late-seral forest would be anticipated to occur for the construction of any of these facilities.

One action, the decommissioning of spawning beaches 1, 2, and 3 near the head of Baker Lake, would occur within mature and/or old-growth forest stands, but would not be expected to require removal of overstory vegetation (refer to Secondary Effects discussion in section 3.3.5.2, Terrestrial Resources, Affected Environment). However, construction could disturb marbled murrelets and northern spotted owls which may nest in old-growth forest adjacent to the spawning beaches. The Proposed Action includes a habitat management measure (Proposed Article 515) that would provide funding to the Forest Service for the actual cost of thinning 321 acres of second-growth forest. This measure would promote the development of late seral habitat characteristics in second growth stands within or adjacent to LSRs. The specific locations of the parcels to be thinned have not been determined. The Proposed Action also includes a measure to develop and implement an Erosion Control Plan, in consultation with the Forest Service (Proposed Article 110). This plan would include identification of sites with specific resource concerns and development, implementation, and monitoring of erosion control treatment methods. This measure would allow identification and protection of specific late seral forest sites along the reservoir margins.

*Effects Analysis*

Implementation of Proposed Article 515 under the Proposed Action would provide thinning of 321 acres of second-growth forest to promote the development of late seral forest characteristics. This measure would mitigate for any new construction that would require clearing vegetation for various fishery enhancement measures. Further, loud noise associated with heavy equipment and pile drivers could disturb marbled murrelets and northern spotted owl which may nest in areas adjacent to where new construction would occur. Implementation of an Erosion Control Plan under Proposed Article 110 would allow identification and protection of specific late seral forest sites at risk of erosion along the reservoir shorelines. We make our final recommendation regarding Proposed Article 515 in section 5.1, Comprehensive Development and Recommended Alternative.

**Wetlands/Amphibian Breeding Habitat—**Current project operation influences the hydrology of shoreline wetlands through fluctuating reservoir water levels. A total of five wetlands (13 acres) have hydrology provided solely by the reservoirs, and a total of 23 wetlands (70 acres) have hydrology provided by a combination of reservoir, shallow groundwater, and/or groundwater discharge.

Amphibian egg masses deposited in ponded areas within the reservoir drawdown zones are subject to flooding and/or desiccation due to reservoir fluctuation (Hamer Environmental and R2, 2003d). Wave action and high rates of water movement may also be detrimental to amphibian eggs, which are sometimes unattached or only weakly attached to submerged vegetation. Optimal breeding and rearing habitat for common northwest pond-breeding amphibians has low current velocity, relatively shallow depths (5 to 16 inches), and a relatively stable water surface elevation (less than 5-inch fluctuation over average depth) between January and May (Richter, 1995). Approximately 231 acres of vegetated habitats currently are present in the drawdown zones of the two reservoirs (Hamer Environmental et al., 2004). These vegetated habitats provide the best potential amphibian breeding habitat within the reservoirs and currently are subject to fluctuating water levels during the amphibian reproductive season.

Under Current Operations, the project would continue to subject documented breeding sites and other potential suitable amphibian breeding habitat to the risk of fluctuating water levels and temperatures, due to regulation of the reservoirs to meet flood control, power generation, fisheries, and/or recreational requirements.

Under the Proposed Action, wetlands with hydrologic connection to the reservoirs would continue to be influenced by reservoir fluctuation. The Proposed Action would not change the general pattern of seasonal reservoir levels, which historically has consisted of average low water surface elevations during the winter and average high water surface elevations during the late spring and summer. Wetlands along the reservoir shoreline dependent upon the reservoirs for part or all of their hydrology would experience the same range of variation as under current operation. Implementation of the Proposed Action is not expected to change the characteristics of wetland plant communities surrounding the reservoirs relative to the current condition. Some shifting of the distribution of vegetated wetlands within the fluctuation zone of Baker Lake could occur, due to the more gradual fall drawdown of the reservoir under the Proposed Action.

The Proposed Action would reduce the risk of flooding or desiccating amphibian breeding habitats in Baker Lake through implementation of the flow regime (Proposed Article 106). The flow regime would hold the reservoir level below the elevation of most documented amphibian breeding sites from late November through the end of March. This period encompasses most of the amphibian breeding season, although breeding and juvenile development may occur through April and May.

Other measures to be implemented under the Proposed Action have the potential to disturb vegetated habitats, including the new auxiliary powerhouse at the Lower Baker Development and installation of fisheries enhancements for production, upstream, and downstream passage (proposed articles 101, 103, 104, and 105). Preliminary siting information for the proposed facilities indicates that high-value wetland habitats

identified in pre-licensing studies (Hamer Environmental et al., 2004) would not be affected by implementation of the aquatic measures. Reservoir drawdown zones would be affected temporarily by the construction of the FSC launch site at the Upper Baker Development and at the Lower Baker Development, if that site is constructed at a later date (refer to Secondary Effects discussion in section 3.3.5.2, Terrestrial Resources, Affected Environment).

The Proposed Action includes a measure (Proposed Article 504, Wetland Habitat) to provide certain funds for the acquisition, enhancement, and management of wetland habitats. The number of acres to be acquired would be determined through consultation with the TRIG and would depend on factors, such as habitat quality, location, and level of enhancement. Proposed Article 505 would provide additional funding for the protection, restoration, and enhancement of low elevation bottomland ecosystems, focusing on aquatic and riparian habitats. It is anticipated that riparian wetland habitats, some of which may provide amphibian breeding habitat, could be a component of the bottomlands managed under this proposed article.

*Effects Analysis*

Proposed Article 504 would require Puget to acquire wetlands and to conserve wetland-dependent species, with priority for acquiring high quality breeding habitat for native amphibians. This measure would mitigate the effects of fluctuating water levels on wetlands adjacent to Baker Lake and Lake Shannon and the effects to amphibians that use these habitats.

However, we note that this proposed article does not specify how many acres of wetlands would be acquired or what management actions would be taken on those lands, once acquired. We make our final recommendation regarding Proposed Article 504 in section 5.1, Comprehensive Development and Recommended Alternative.

**Special Status Plant Species**

Several special status plant species are known to occur in the project area and Baker River basin. Many of these species are designated special status due to their rarity in the region.

Current project operation could negatively affect populations of special status plant species through recreational activities at both developed and dispersed sites, water-level fluctuations, and habitat-disturbing activities associated with project operation and maintenance.

Under the Proposed Action, the project could negatively affect populations of special status plant species through the same types of activities and through facility upgrades. Refer to Secondary Effects discussion in section 3.3.5.2, Terrestrial Resources,

Affected Environment, for description of the Lower Baker power plant modifications and of aquatic and recreational measures with potential to affect terrestrial habitats.

The Proposed Action includes a measure for the development and implementation of a special status plant management plan (Proposed Article 509, Plants of Special Status). Under the plan, Puget would: (1) survey all sites of proposed project disturbance/activity with the potential to affect special status plants; (2) develop site-specific management plans for 10 known sites supporting special status plant populations that may be affected by Project disturbance/activity; (3) develop a process for assessing and preventing conflicts between special status plants and project -related activities that emerge during the term of any new license issued; (4) develop a monitoring and evaluation program for threatened and endangered species plant locations within the area affected by the project; and (5) update the plan within one year of the addition of a species to any of the special status categories.

The Proposed Action also includes a measure for specifying the development and implementation of a site-specific management plan for yellow sedge (*Carex flava*) at a site near the head of Baker Lake (Proposed Article 510). This measure includes inventory, reed canarygrass control measures, and monitoring and evaluation of the yellow sedge population.

*Effects Analysis*

Proposed Article 509 would protect special status plants including federal and state listed endangered, threatened and proposed plants and plants on the Forest Service's regional list of sensitive species. All areas where project-related ground disturbance would occur would be surveyed to identify any special status plants. Certain known populations of special status plants, identified during relicensing studies, would also be protected.

Implementation of a yellow sedge management plan (Proposed Article 510) would help protect this species which exists adjacent to Baker Lake. Under the plan, Puget would inventory and map known populations; control reed canarygrass which can compete with this species; and replant yellow sedge if the population decreases by more than 20 percent. We note that special status plant management would occur on some lands that are not within the project boundary. We make our final recommendation regarding proposed articles 509 and 510 in section 5.1, Comprehensive Development and Recommended Alternative.

**Noxious Weeds and Invasive Non-native Plant Species**

Noxious weeds and invasive non-native plant species are known to occur in the Baker River basin. These species can be aggressive, out-competing native plant species, reducing the value of wildlife habitat, and affecting waterways and aquatic habitats.

Roads, trails, boat launches, and other areas of vehicle, pack animal, and foot traffic are typical sites of initial establishment of weed populations. Disturbed soils are susceptible to colonization by weedy species, including non-native invasives. The Baker River Project access roads, recreational facilities, and other project facility sites may have contributed to the occurrence of weed species in the basin. Currently, Puget implements weed control activities at project facilities at both Upper and Lower Baker dams, West Pass dike, and selected boat ramps and campgrounds.

Current project operation would continue to provide avenues for weed introduction and establishment along access roads, recreational facilities, boat launches, and the unvegetated portions of the project reservoir fluctuation zones.

Under the Proposed Action, Puget would develop and implement a noxious weed management plan (Proposed Article 508) for project lands and other sites surveyed during relicensing studies (Hamer Environmental and R2, 2003c). The plan would address site-specific and species-specific management and monitoring programs for noxious weeds and would replace (and incorporate as appropriate) current noxious weed management practices for the project. The plan would include inventory, treatment, monitoring, and updating of species lists and management techniques on an established schedule. The plan would be consistent with Forest Service, other federal, state, and county weed regulations and policy

Proposed Article 508 includes specific components to guide weed management activities on National Forest System lands. Prevention of weed introduction and establishment would be accomplished by implementing Amendment #14 to the Forest Service Mt. Baker-Snoqualmie Forest Plan: Best Management Practices for Prevention of Noxious Weeds (Forest Service, 1999, appendix C). Updates to the best management practices would be implemented within six months of issuance to Puget. If new, high priority (e.g., Class A or B designate) noxious weeds are discovered within the project area, they would be treated in the most effective manner possible, within the guidelines and recommendations of the Region 6 EIS for preventing and managing invasive plants (Forest Service, 2004b; Record of Decision expected during 2005). Revegetation on Forest Service lands would follow Forest Service Region 6 policy regarding native plant movement. Use of desirable non-native species would follow the recommendations in the *Mt. Baker-Snoqualmie National Forest Native Plant Notebook* (Potash and Aubry, 1997), or subsequent Region 6 guidance.

Based on relicensing surveys, site-specific weed treatments are proposed for a total of 54 sites on Forest Service lands totaling over 14 acres (table 3-25). Potential treatment methods include manual methods, such as hand pulling and grubbing; physical methods, such as mowing or cutting; biological control; herbicide application; and control by planting other species to shade out the populations.

Under Proposed Article 508, weed sites on non-Forest Service lands would be evaluated to determine the need for treatment and the appropriate potential treatment methods in consultation with the TRIG.

Table 3-25. Noxious weed sites and treatment methods available for National Forest System lands under Proposed Article 508, Noxious Weed Management Plan.

| Species | Common Name | No. Sites on Forest Service Lands | No. Acres on National Forest Service Lands | Proximity to Water | Potential Treatment Methods[a] |
|---|---|---|---|---|---|
| *Cirsium arvense*[b] | Canada thistle | 12 | 3.30 | Many sites below full pool, along streams | Manual control: hand pulling, mowing<br>Biological control<br>Herbicide application: Picloram or Glyphosate (Rodeo®)<br>Shade planting |
| *Cirsium vulgare*[b] | Bull thistle | 12 | 7.86 | Many sites below full pool, along streams | Manual control: hand pulling, mowing<br>Biological control<br>Herbicide application: Picloram or Glyphosate (Rodeo®)<br>Shade planting |
| *Cytisus scoparius*[b] | Scotch broom | 4 | 0.15 | Upland sites | Manual control: hand pulling, cutting, mowing<br>Biological control<br>Herbicide application: Picloram or Glyphosate (Rodeo®)<br>Shade plantings in conjunction with other treatments |
| *Geranium robertianum*[b] | Herb Robert | 15 | 2.98 | Some wetland sites | Manual control: hand pulling, mowing<br>Herbicide application: Picloram or Glyphosate (Rodeo®) |
| *Hedera helix*[b] | English Ivy | 1 | < 1 | Near old spawning beach, | Manual control: cutting, hand pulling and grubbing |

| | | | | | |
|---|---|---|---|---|---|
| | | | | Baker Lake | Herbicide application with surfactants |
| *Phalaris arundinacea*[b] | Reed canarygrass | 7 | No estimate available | All 7 sites are wetlands | Manual control: hand pulling, mowing<br>Herbicide application: Glyphosate (Rodeo®) |
| *Senecio jacobaea*[b] | Tansy ragwort | 2 | < 1 | Upland sites | Manual control: hand pulling<br>Biological control<br>Herbicide application: Glyphosate (Rodeo®)<br>Shade plantings and healthy plant communities |
| *Polygonum cuspidatum*[c] | Japanese knotweed | 1? | No estimate available | Wetland site | Manual control: cutting/bending stems, mowing<br>Herbicide application: Glyphosate (Rodeo®), Picloram, Dicamba, others<br>Shading |

[a] If new, high priority (e.g., Class A or B designate) noxious weeds are discovered within the project area, they will be treated in the most effective manner possible, within the guidelines and recommendations of the Region 6 EIS for Preventing and Managing Invasive Plants.

[b] Species identified in Hamer Environmental and R2 (2003c).

[c] Species not identified in Hamer Environmental and R2 (2003c).

*Effects Analysis*

Implementation of the noxious weed management plan would reduce the introduction, establishment, and spread of noxious weeds in the project area and the basin. Puget's current weed management activities would be replaced and/or supplemented with an integrated weed management program. By reducing noxious weed populations, this measure would contribute to the enhancement and protection of native plant and wildlife habitats.

On Forest Service lands, infestations of Scotch broom, English ivy, and tansy ragwort are located at upland sites and are small in area. Treatment of these sites by any of the proposed treatment methods would be expected to cause less than one acre of ground disturbance; effects of herbicide treatment would be dependent upon the application method, timing of application, and presence of other species with potential to receive herbicide "drift." Other species targeted for treatment occur in large patches often within wetlands or adjacent to waterways. Herbicide application in these areas would be consistent with Forest Service and state protocols for protection of water quality and other natural resources. All weed treatment activities would be implemented in accordance with Proposed Article 508, Noxious Weeds, and existing regulations and policies regarding protection of fish and wildlife species. We note that noxious weeds would be controlled on some lands that are not within the project boundary. We make our final recommendation regarding Proposed Article 508 in section 5.1, Comprehensive Development and Recommended Alternative.

**Wildlife and Special Status Wildlife Species**

**Elk Foraging Habitat—** The Nooksack Elk Herd provides recreational, aesthetic, spiritual, and subsistence values to residents of northwestern Washington. The herd is the smallest in Washington and has decreased in size over the past 15 years. Foraging habitat may not be a limiting factor to the herd at present, but the availability of forage in the future is a concern. The Baker River Project is located on the eastern edge of the Nooksack herd's range.

Human activity associated with current operation of the project has the potential to disturb elk, displacing them temporarily or permanently from otherwise suitable habitats surrounding the project.

Under the Proposed Action, human activity associated with the project could disturb elk that may be foraging or traveling through the area. The Proposed Action includes a measure (Proposed Article 503) to provide several tracts of elk foraging habitat within the range of the Nooksack herd. Approximately 300 acres, with an elk forage equivalency value of at least 1,437, would be acquired and habitat management activities, including planning, enhancement, and noxious weed management would occur.

Annual planning, habitat enhancement and management would be performed for those lands that are acquired. Proposed Article 503 specifies geographic criteria to be used in parcel selection and describes the roles of the WDFW and TRIG in implementing the proposed article.

*Effects Analysis*

Implementation of the elk forage enhancement action (Proposed Article 503) would ensure the availability of a minimum of 300 acres of good quality elk foraging habitat for the term of any new license. This measure would benefit elk in the Nooksack herd by providing a reliable source of elk forage in the Baker River study area, where currently almost 60 percent of the elk forage habitat is rated marginal or poor. This proposed article would contribute to the objectives of the WDFW Nooksack Herd management plan (Davison, 2002) through maintaining elk habitat capability on non-state lands and through enhancing habitat quality on primary elk range. However, it appears that opportunities to enhance habitat or acquire lands in accordance with this proposed article exist closer to the project than the geographic preferences stated in the proposed article. We make our final recommendation regarding Proposed Article 503 in section 5.1, Comprehensive Development and Recommended Alternative.

**Mountain Goat Summer Habitat—**Mountain goat populations in the area around Mt. Baker have declined gradually over the past several decades (Forest Service, 2002b). A shortage of usable summer habitat has been proposed as a factor contributing to this status. Summer foraging habitat comprises alpine shrubs and grasses; this habitat is believed to have decreased in area over the past 100 years due to encroachment by closed-canopy mountain hemlock forest. Goats may be restricted from using remaining suitable habitat by the presence of high-country recreationists.

Based on studies conducted during relicensing, mountain goat use of summer range in the Baker River watershed is being affected by recreational activity (R-13 Study, Huckell/Weinman Associates, 2004c). Existing project-induced recreation may account for a portion of the recreational use impact believed to be affecting mountain goats on their summer range in the Baker River basin and adjacent areas. Ongoing operation of the project is expected to continue to contribute somewhat to backcountry recreational activity at levels similar to current levels.

Under the Proposed Action, backcountry recreational activity would continue at levels similar to or slightly greater than current levels, providing potential for disturbance of goats on summer range. The Proposed Action includes a proposal (Proposed Article 516) to provide funding to compensate the Forest Service for the costs of habitat improvements in mountain hemlock forest in occupied mountain goat summer range on Forest Service lands in or adjacent to the Baker River watershed. This measure would

fund planning, environmental review, and implementation for the enhancement of up to 194 acres. The specific methods for accomplishing the canopy thinning may include prescribed burns or other means in high elevation forest areas away from established recreation areas in the project vicinity.

*Effects Analysis*

According to Puget, existing project-induced recreation may account for a portion of the recreational use impact believed to be affecting mountain goats on their summer range in the Baker River basin and adjacent areas. Ongoing operation of the project is expected to continue to indirectly contribute somewhat to backcountry recreational activity at levels similar to current levels.

Proposed Article 516 would require Puget to provide funding to the Forest Service for its actual costs in making habitat improvements on 194 acres of mountain hemlock forest on Forest Service lands in or adjacent to the Baker River basin. This measure was included in the Settlement Agreement to mitigate for apparent backcountry hikers which may originate from the project.

However, backcountry hiking and recreation activities which occur in high-elevation areas away from the project are not project effects. All existing project recreation facilities are in the immediate vicinity of Baker Lake and Lake Shannon. All staff-recommended trails would also be in the lower elevations of the Baker River valley and not in elevations that would affect mountain goats. We make our final recommendation regarding Proposed Article 516 in section 5.1, Comprehensive Development and Recommended Alternative.

**Osprey Nest Structures—**Lake Shannon supports a relatively stable population of osprey, with an average of seven breeding pairs during the last 11 years (Puget, 2002f; Puget, 2004c). Currently, nesting occurs on both natural snags and on artificial nesting platforms. Due to the limited availability of natural nest structures and the recent losses of in-reservoir snag nest sites from decay, artificial nest structures are key to maintaining stable osprey populations at Lake Shannon in the future.

Current project operation would result in continued implementation of Puget's informal artificial nest structure maintenance program. Currently, nine nest structures are installed at Lake Shannon.

Under the Proposed Action, Puget would implement a formal, expanded nest structure maintenance program (Proposed Article 506). Under this proposed article, one additional nest platform would be installed within 1 year of license issuance. A total of 10 artificial nest structures would be inspected on a 2-year cycle and maintained in

condition suitable for use by nesting osprey. Puget would also modify 10 existing trees along the shoreline to promote their eventual use as osprey nest sites. Ten trees would be selected on lands owned and/or controlled by Puget in sites suitable for osprey nesting; modification of the trees may include topping or killing, based on site-specific evaluation. Puget would monitor osprey nesting and productivity annually during the breeding season of April 1 to August 31 at both Lake Shannon and Baker Lake.

*Effects Analysis*

Implementation of the nest structure maintenance program would ensure that osprey nest sites in excess of the current average number of breeding pairs would be available at Lake Shannon during the term of any new license issued. This would allow the average number of breeding pairs (seven) to be maintained. In addition, 10 existing trees surrounding the lake would be modified to promote the eventual development of natural nest sites for osprey. Annual productivity surveys at both Baker Lake and Lake Shannon would monitor osprey use of the project reservoirs and nest structures and provide information for future adaptive management decisions. We make our final recommendation regarding Proposed Article 506 in section 5.1, Comprehensive Development and Recommended Alternative.

**Common Loon Floating Nest Platforms—**Common loons are frequently observed on project reservoirs but have never been observed nesting. The absence of loon nesting may be related to the lack of suitable nest sites along the reservoir shorelines, effects of reservoir fluctuations, and/or human disturbance.

The Proposed Action includes a measure to increase the suitability of loon nesting habitat through installation of floating nest structures and implementation of human-use restrictions at nesting sites (Proposed Article 507). Floating nest platforms have been shown to be successful in some reservoirs (Piper et al., 2002), providing loons the predator protection and accessibility found in natural floating nests (Richardson et al., 2000). Within 1 year of license issuance, Puget would install a total of three floating nest platforms in suitable locations in one or both of the project reservoirs, consistent with Proposed Article 304, Baker Reservoir Recreation Water Safety Plan. Log booms, boundary buoys, or other appropriate devices would be placed around each nesting platform to establish use restriction zones for the purpose of limiting human disturbance. Nesting platforms and public access restriction devices would be in place by April 1 and removed by July 31 each year. Puget would monitor the three platforms for 15 years to determine nesting activity and the effectiveness of access restriction devices. The proposed article specifies elements to be included in the monitoring report and requires the program to be expanded by an additional three platforms if nesting success is determined. Up to one platform could be substituted with funding to a third-party for a nesting platform on non-project reservoirs.

*Effects Analysis*

Implementation of this measure would enhance nesting conditions for common loons by providing new, suitable nesting structures and enhanced nest site security at project reservoirs for a minimum trial period of 15 years. If the program is successful, it would be expanded and continued beyond the initial 15-year period. However, we note that Puget could substitute the placement of one floating nest platform by making funding available to a third party for a nest platform on a non-project reservoir. This action may not be necessary because opportunities exist on project reservoirs for these platforms. We make our final recommendation regarding Proposed Article 507 in section 5.1, Comprehensive Development and Recommended Alternative.

**Decaying and Legacy Wood—**Snags and logs provide nesting, roosting, and feeding habitats for a wide variety of native vertebrate species and are considered a WDFW Priority Habitat. Many snags in and adjacent to Lake Shannon have deteriorated and fallen over time, reducing available habitat to species such as tree swallow. Much of the forested habitat surrounding Lake Shannon has been subject to timber harvest, and snag and downed log densities are relatively low compared to stands of late successional and old-growth stages.

Current project operations do not provide management of snag, log, and residual live tree habitats.

Under the Proposed Action, Puget would implement a plan for the management of decaying and legacy wood (Proposed Article 511) on all existing or acquired project lands. The plan would include methods to retain existing snags, logs, and residual live trees; to promote the natural development of these features where they do not exist; and, if needed, to provide artificial structures to meet short-term habitat needs. Puget, in collaboration with the TRIG, would determine the specific target numbers of these habitat features to be retained/created within each habitat type.

*Effects Analysis*

Implementation of the plan for management of decaying and legacy wood would protect and promote the development of snag, log, and residual live trees on project lands for the purpose of enhancing habitat value to snag- and log-dependent species. Decaying and legacy wood structure provides important nesting, roosting, and feeding habitats for cavity excavators and nesters, residual live tree nesters, and species relying on dead and down wood. For example, studies have shown that nest site availability is a limiting factor to tree swallows, which cannot excavate their own cavities (Stutchbury and Robertson, 1985). This measure would be consistent with the WDFW management recommendations for protection and enhancement of snag and log habitats. We make our

final recommendation regarding Proposed Article 511 in section 5.1, Comprehensive Development and Recommended Alternative.

**Salmonid Nutrient Resource Management—**Marine nutrients accumulate in the body mass of Pacific salmon and are transported to and deposited in freshwater habitats where salmon spawn and die. These nutrients are incorporated into the food web via: (1) direct consumption of salmon eggs and flesh by fish and invertebrates, and (2) chemical or biological uptake of dissolved materials released from fish metabolism and carcass decomposition (Naiman et al., 2002). Bald eagle, American black bear, common merganser, grizzly bear, harlequin duck, osprey, and northern river otter exhibit strong and consistent links to salmonids, through egg, juvenile, adult, and/or carcass stages.

Under the Proposed Action, Puget would provide fish propagation and enhancement programs and facilities (Proposed Article 101), upstream passage for migratory fish species (Proposed Article 103), assessment of connectivity barriers and implementation of improvements between Baker Lake and Lake Shannon (Proposed Article 104), and downstream passage facilities for migratory fish (Proposed Article 105. These actions would increase fish production over the levels currently supported in the reservoirs and Baker River system. Other measures to be implemented for enhancement of aquatic habitats include a reservoir and Lower Baker River FIP (Proposed Article 106), plans to address gravel and LWD management (proposed articles 108 and 109), shoreline erosion and water quality measures (proposed articles 110 and 401), and a plan to protect, restore, and enhance aquatic and riparian habitats (Proposed Article 505). These measures would benefit fisheries resources in the Baker River basin; Proposed Article 106 would benefit fish in the Lower Skagit River basin.

*Effects Analysis*

Under the Proposed Action, installation of improved upstream and downstream migratory fish passage facilities (proposed articles 103 and 105) would be expected to contribute to an increase in overall fish populations for anadromous species. Supplementation programs also would contribute to the availability of salmonid-based nutrients in the basin. Implementation of Proposed Article 101 would be expected to approximately triple the current level of sockeye salmon juvenile releases to the Baker River watershed. Under the Proposed Action, sockeye returns to the Baker River watershed would likely be substantially increased. Based on current spawning beach operations, approximately 4,500 sockeye adults would be transported to the spawning beach each year. Up to 8,500 returning adults would be used in the hatchery, once both phases are in operation. Adults in excess of spawning beach, hatchery, and tribal harvest requirements would likely be released to Baker Lake. In addition, carcasses from the hatchery and spawning beach facilities would be distributed within the basin.

Proposed Article 106 would be expected to substantially reduce the potential for fish stranding and decrease redd dewatering in the Skagit River downstream of the Baker River confluence (section 3.3.4.2). This could contribute to increased production of anadromous fish, and associated marine-derived nutrients, in the Lower Skagit River basin.

**Wildlife Plan**

Current project operation does not include a wildlife management plan.

Under the Proposed Action, Puget would provide a comprehensive terrestrial resources management plan (Proposed Article 501) within 1 year of license issuance. The terrestrial resources management plan (TRMP) would be developed by Puget in consultation with the TRIG and would provide planning and implementation requirements consistent with the lands, budgets, and ranges of management options identified in the following proposed articles: 502, Forest Habitat; 503, Elk Habitat; 504, Wetland Habitat; 506, Osprey Nest Structures; 507, Loon Floating Nest Platforms; 508, Noxious Weeds; 509, Plants of Special Status; 510, Carex flava; 511, Decaying and Legacy Wood; 512, Bald Eagle Winter Roost Surveys; 513, Bald Eagle Management Plans; and 514, Use of Habitat Evaluation Procedures. The TRMP would include a schedule for monitoring as required by proposed articles 506, 507, 508, 509, 510, and 514. Annual budgetary reporting would be required for all proposed terrestrial license articles (501 through 517).

*Effects Analysis*

Proposed Article 501 would require Puget to develop a Terrestrial Resource Management Plan that would include the substantive planning and implementation requirements contained in Proposed Articles 502-504 and 506-514; provisions for monitoring and filing annual reports with the Commission; provisions for periodically reviewing the plan and; a summary of expenditures, earned interest, disbursements, adjustments for inflation, and other accounting information.

However, this proposed measure does not contain substantive requirements but instead would consolidate the planning and implementation requirements of most other proposed terrestrial measures into one plan. We make our final recommendation regarding Proposed Article 501 in section 5.1, Comprehensive Development and Recommended Alternative.

**Habitat Monitoring**

Habitat monitoring is a valuable tool to measure the progress made toward achieving the measurable biological objectives established for terrestrial resources.

Current operation of the project does not include a formal program of wildlife habitat monitoring.

Under the Proposed Action, Puget would periodically assess the quantity and quality of managed wildlife habitat parcels to determine the effectiveness of implementing proposed articles 502, Forest Habitat; 503, Elk Habitat; 504, Wetland Habitat; 506, Osprey Nest Structures; 507, Loon Floating Nest Platforms; and 513, Bald Eagle Management Plans. The FWS Habitat Evaluation Procedures (HEP), or other appropriate methodology selected in consultation with the TRIG, would be used.

*Effects Analysis*

Under the Proposed Action, a HEP or similar methodology would be used to provide assessment of habitat conditions on lands managed under proposed articles 502, 503, 504, 506, 507 and 513, at a minimum of two, and maximum of three, points in time. The assessments would provide information on habitat quantity and quality over time on lands managed for terrestrial resources. Information gathered during monitoring would be considered in the continued implementation of management activities under these proposed articles, in consultation with the TRIG. We make our final recommendation regarding Proposed Article 514 in section 2.0, Comprehensive Development and Recommended Alternative.

**Ongoing Terrestrial Resource Needs**

Resource management objectives, habitat conditions, and wildlife enhancement and protection needs relative to the Baker River Project may change during the term of any new license issued. Individual measures incorporate a reasonable range of expected outcomes and management adjustments. A fund, under the management of Puget and overseen by project area wildlife managers, could be used to respond to unforeseen outcomes, new resource management issues, and adaptive management decisions.

Under the Proposed Action, Puget would establish the BRCC and three technical subgroups, including the TRIG (Proposed Article 601). Under the related Proposed Article 602, Required Funding, funds would be established to support resource protection, mitigation, and enhancement measures. The funds are intended to offset existing or unforeseen impacts on fish, wildlife, and cultural resources and to address unanticipated increases in recreation demand; they may also be used to implement alternative strategies for resource protection, mitigation, and enhancement identified under the provisions of Proposed Article 603. One of the four separate funds comprising the Baker River Project Funds would be the Terrestrial Enhancement and Research Fund (TERF). Proposed Article 602 specifies the annual funding level for the TERF. The TERF may be used for actions to enhance, conserve, acquire and/or restore habitat for

terrestrial species. All projects would be funded only with TRIG approval and would be located in the Skagit River basin, with emphasis on the Baker River basin.

*Effects Analysis*

Although Puget provides some examples of how TERF funds may be used, Puget does not provide any specific measures to be implemented using these funds. Without specific measures, we cannot evaluate the fund's environmental effects or the fund's nexus to the project. We make our final recommendation regarding the TERF fund and Proposed Article 602 in section 5.1, Comprehensive Development and Recommended Alternative.

***Secondary Effects of Proposed Measures***

**Terrestrial Resources Measures**

**Lower Baker Power Plant Modifications—**The Proposed Action includes a proposal for rehabilitating the original power generating facilities at the Lower Baker Development that were destroyed by a 1965 landslide (refer to section 3.2.1). The powerhouse upgrade would include two new turbine generators installed on existing penstocks within the concrete foundation of the original 1925 powerhouse located adjacent to and immediately north (upstream) of the existing Lower Baker powerhouse.

Vegetation along the Baker River shoreline in the vicinity of the power plant rehabilitation site consists of young deciduous riparian forest that regenerated after the 1965 slide. Red alder is the dominant species with minor components of black cottonwood and conifers. An area estimated to be less than one acre would be cleared of vegetation along the shoreline for construction of the access platform and excavation of the former powerhouse site. The footprint of the new powerhouse, located on the former powerhouse site, would be about 0.4 acre. Equipment staging and excavated materials storage would occur on Puget properties at the Lower Baker Development and would not involve vegetation clearing.

Young deciduous riparian forest is a relatively uncommon habitat type in the Baker River basin and is valuable to a variety of wildlife species. The Proposed Action includes a proposal for the acquisition and management of deciduous forest habitats (Proposed Article 502). Construction activity is expected to occur primarily during a 24-month period, with winter outdoor work shutdowns occurring between late November and early March. Preliminary site investigations and excavation of old facilities would occur over an approximate 3-month period prior to the construction. Instream work on the access platform would occur during low-flow periods. Noise and human activity associated with the construction may disturb wildlife temporarily, precluding use of

habitats in the immediate vicinity of the construction site. This temporary disturbance is not expected to significantly affect populations of any wildlife species.

**Aquatic Resources Measures**

**Fish Propagation and Enhancement Programs and Facilities—**Under Proposed Article 101, fish propagation and enhancement programs at the Baker River Project would be expanded. Sockeye Spawning Beach 4, located downstream of the Upper Baker dam near the confluence of Sulphur Creek and the Baker River, would be modified and/or upgraded with ancillary facilities. A new fish culture facility would be constructed adjacent to Spawning Beach 4, as an expansion of the current rearing facility. The fish hatchery would be constructed in the cleared and fenced area on the right bank of the Baker River near the Sulphur Creek confluence. This site is located within the current special use permit area for the existing sockeye facilities. Based on preliminary siting information, it is expected that construction of these facilities would entail clearing of weedy forbs on previously disturbed sites within the current special use permit area, and would not affect native plant communities. Total area to be cleared is estimated at less than 2 acres.

Existing Spawning Beaches 1, 2, and 3 at the upper end of Baker Lake would be decommissioned, including restoration of vegetation along Channel Creek. Noise and human disturbance associated with this activity could potentially disturb wildlife in the vicinity. Decommissioning of the site would be scheduled during the low water season because of the need for instream work. No removal of overstory trees is expected to occur.

Another effect of the fish propagation and enhancement activities would be an increase in sockeye returns to Baker Lake (section 3.3.4.2). An increase in anadromous fish would benefit bald eagles and other wildlife that rely on fish and fish carcasses for a food resource. The spawned out fish also would contribute to the supply of marine-derived nutrients in the basin.

**Upstream Passage Facilities—**Proposed Article 103, Upstream Passage Implementation Plan, would provide attraction, capture, and transport facilities for upstream migrating fish at the Lower Baker Development. The trap-and-haul facility, and associated crowding and sorting areas, would be constructed in the vicinity of the existing facility. Habitat in the area is dominated by the current facilities, riprapped river banks, parking areas, and adjacent disturbed vegetation. Preliminary information on siting and design indicates that upgrade of the existing facility would not require any substantial clearing of native plant communities. Total area to be cleared is estimated at less than 1 acre.

Proposed Article 104 would provide a fishway between Lake Shannon and Baker Lake for the passage of native char and other native fish species. The fishway design options include a temporary or permanent trap-and-haul facility or a weir and trap; location options include Sulphur Creek and the base of Upper Baker dam. Although final design and siting information are not available at this time, it is anticipated that the construction of the facility would involve clearing of approximately 1 to 2 acres of habitat that may consist of young deciduous forest, disturbed weedy habitats in and near the Sulphur Creek spawning beach, and/or other habitats. Construction of the fishway is expected to create a low to moderate level of noise disturbance for a period of relatively short duration.

Over the long-term, improvements in upstream passage for migratory fish would benefit wildlife species dependent upon salmon as a food resource. Other species, and the ecosystem, would benefit from the additional marine-derived nutrients provided by the salmon.

**Downstream Passage Facilities—**Downstream passage facilities for migratory fish would be provided at both Upper and Lower Baker developments (Proposed Article 105). Many of the components would be located within the reservoirs and would not affect vegetated habitats. Installation of the FSC facility, however, would require a temporary construction and launch site at each reservoir. A diked area of approximately 2 acres in size would be constructed, extending from above the shoreline into the reservoir drawdown zone. Associated features include a sediment control pond, laydown area, and access road. Total area to be occupied by these features is approximately 7 acres, including both vegetated uplands and non-vegetated areas below the normal high water elevation (MWH, 2005).

Existing vegetation at the site consists of upland mixed conifer/deciduous forest, upland deciduous forest, and intermittently flooded portions of the reservoir drawdown zone (Hamer Environmental et al., 2004). Deciduous trees and shrubs at the site include red alder, black cottonwood, bigleaf maple, vine maple, Scouler's willow, mountain ash, salmonberry, thimbleberry, red elderberry, and red-osier dogwood. Coniferous tree species at the site include western red cedar and Douglas fir. Much of the area has been cleared and is characterized by regenerating stands. Sword fern, trailing blackberry, low Oregon grape, and the invasive species Himalayan blackberry are also present. Shoreline areas are dominated by Sitka willow and the invasive weed, reed canarygrass. Most of the proposed construction site is located in the drawdown zone, where there is little or no vegetation due to water fluctuations.

Upon completion of installation of the FSC, the temporary construction and launch site would be removed and portions of the affected area not needed for operation of the

facility would be restored. Restoration of upland habitats would be performed using native tree, shrub, and grass species suited to the site in accordance with Proposed Article 508 guidelines on native plant movement and best management practices for prevention of noxious weeds. The restoration planting goals and objectives are as follows: (1) provide in-kind or greater replacement of existing vegetation affected by construction; (2) provide diversity in replacement plant species to enhance wildlife habitat; (3) provide soil stabilization with planting of scrub/shrub planting and herbaceous erosion control seeding along the shorelines' normal high water line; and (4) replace existing LWD affected by construction using existing trees cleared for construction. Restoration grading and planting plan details are provided in Appendix 1 of the Stormwater Pollution Protection and Water Quality Plan (MWH, 2005).

Construction activity at this site is expected to occur over an approximately 2.5-year period. Construction of the launch facility would take just over 2 months during late fall/early winter and would involve earth-moving work, construction and compaction of the embankments, and driving of sheet pile. The following August, construction would begin on the FSC; and would continue through July of the following year. During August, the FSC would be launched. Finally, grading and restoration of the site would occur during November to March following the launch of the FSC. FSC launch site construction activities would be expected to include temporary increases in noise levels associated with heavy equipment and pile-driving activities during berm construction and from vehicles and activities during the construction of the FSC. Noise generated by heavy equipment and construction personnel may cause localized, short-term disturbance of wildlife on the reservoir, shoreline, and upland areas in the vicinity of the launch site.

At the Lower Baker Development, a potential site for construction of the FSC has been identified near the existing boat ramp; the FSC structure would be towed from this site to the installation site at the dam. We estimate that up to 7 acres of vegetated and non-vegetated habitats would be affected by the construction of the FSC launch facility. Most of the areas in the vicinity of the dams have been previously cleared as part of the construction and operation of the facilities. Existing cover types in the vicinity include project facilities, upland deciduous forest, and upper perennial and intermittently flooded portions of the reservoir drawdown zone. Portions of the site not needed for operation of the FSC would be restored after completion of construction using native plant species suited to the site in accordance with Proposed Article 508 guidelines on native plant movement and best management practices for prevention of noxious weeds. Most of the proposed construction site is located in the drawdown zone, where there is little or no vegetation due to water fluctuations.

Construction sequencing, duration, and noise-generating activities at the Lower Baker Development site are expected to be similar to those described above for the Upper

Baker Development. Construction of the Lower Baker launch facility would be initiated after completion of the Upper Baker FSC.

A series of stress-relief ponds would be constructed near the confluence of the Baker and Skagit rivers. Preliminary information indicates that the ponds would consist of a series of three raceways located along the Lower Baker River near the Lower Baker compound area south of the administration building. This site is highly disturbed and largely non-vegetated. The ponds, access areas, and associated berms are estimated to occupy less than one acre.

Proposed articles 508, Noxious Weeds, and 509, Plants of Special Status, would be implemented where applicable. These measures would provide protection of special status plant species, management of noxious weeds, and revegetation of disturbed sites with appropriate plant species.

Over the long-term, improvements in downstream passage for migratory fish would benefit wildlife species dependent upon salmon as a food resource. Other species, and the ecosystem, would benefit from the additional marine-derived nutrients provided by the salmon.

#### 3.3.5.3 Unavoidable Adverse Effects

None.

#### 3.3.5.4 Cumulative Effects

**Wildlife Habitats (Mature and Old-Growth Forest, Deciduous Forest, and Riparian Habitats)**

Commercial timber harvest occurred on private, state, and federal lands in the forested stands of the Baker River basin prior to, during, and following the development of the Baker River Project. The original construction of the Baker River Project affected forested habitats, including harvested stands, mature and old-growth stands, and riparian habitats. In the 1990s, commercial timber harvest activity came to a virtual standstill on National Forest System lands in the basin, due to protections for species inhabiting late and old-successional forest. Currently, about 61 percent of the coniferous forested habitats on National Forest System lands are mature and old-growth coniferous forest. Lands surrounding Baker Lake and higher in the basin are predominately mature and old-growth forest, although remaining stands at low to mid-elevations on the west side of Baker Lake have been highly fragmented. Private and state timber lands surrounding Lake Shannon are dominated by second- and third-growth coniferous forest and currently support little or no old-growth. Deciduous forest stands that have developed in response to timber harvest are distributed throughout the managed timberlands. Riparian habitats,

some of which are dominated by deciduous trees and shrubs, remain essentially undisturbed by human activity within mature and old-growth forests, and in varied condition within harvested areas.

The majority of late and old-successional forests, deciduous forests, and riparian habitats surrounding Baker Lake and higher in the basin are protected under the provisions of the Northwest Forest Plan (Forest Service and BLM, 1994b, 2001); these protections are expected to remain in place in the future.

State and private timberlands surrounding Lake Shannon are expected to be managed for timber resources in the future, resulting in continued rotation of forest stand ages. It is also possible that private timberlands would be converted in the future to residential sites. Deciduous forest stands that have developed in response to timber harvest are expected to continue to occur in the future on lands managed for timber production. Riparian habitats are currently protected under Washington State Forest Practices Rules; these protections are expected to remain in effect in the future.

Several measures under the Proposed Action would cumulatively contribute to the protection and enhancement of forested wildlife habitats compared to existing conditions. The habitat management program discussed in Proposed Article 502 would provide funding for acquisition and enhancement of deciduous forest habitat. The elk forage habitat program (Proposed Article 503) would provide an initial tract of 300 acres of elk foraging habitats, plus certain funding for additional habitat acquisitions. It is anticipated that some of the elk forage habitat parcels would be located within forested stands. Proposed Article 515 would provide funding to thin 321 acres of second-growth forest to promote late-seral forest characteristics. Rare plants would be protected within forest stands potentially affected by project-related activities, per specifications of proposed articles 509 and 510. Noxious weeds would be managed on lands affected by the project under Proposed Article 508. Snags, logs, and residual live trees would be managed on project lands through Proposed Article 511.

Reservoir shoreline erosion and rehabilitation of the original powerhouse at the Lower Baker Development have the potential to affect small areas of coniferous, mixed coniferous-deciduous, and deciduous forest of various ages. Based on preliminary information, it is anticipated that powerhouse reconstruction at the Lower Baker Development would affect approximately one acre of young deciduous riparian forest. Aquatic measures may affect up to 20 acres of habitats; most of this habitat is within reservoir or located in areas already cleared and occupied by project facilities. Implementation of proposed articles 502, 503, and 515 would fund the acquisition and enhancement of a minimum of 300 acres specified for elk forage, additional deciduous

forest habitat, and enhancement of 321 acres of second-growth forest to promote late-seral stage characteristics.

**Wetlands**

Cumulative effects on wetlands in the Baker River basin have occurred primarily through timber harvest activity, including clearing, modification of hydrology, and road construction. The quality and function of some basin wetlands have been reduced from historical conditions due to land management activities. The original development of the Baker River Project affected wetlands through inundation of vegetated wetlands plus additional open-water habitat. Some of the wetlands adjacent to the project reservoirs rely, to an unknown degree, on hydrology provided by the reservoirs. Although reservoir water levels vary greatly over the short term, the long-term operating pattern of average low water surface elevations during the winter months and average high water surface elevations during the late spring and summer months has remained constant. Wetlands dependent on reservoir hydrology have been subjected to this hydrologic cycle since project construction and are believed to have reached a relatively steady-state condition.

Wetland habitats remaining in the basin are largely protected by federal and state regulations; these protections are expected to remain in effect in the future. Under the Proposed Action, wetland habitats would be acquired, protected, and/or enhanced under Proposed Article 504. Management to protect and enhance these habitats would improve their functions and values, including wildlife habitat value, over time.

The Proposed Action would not change the general pattern of seasonal reservoir levels, which historically has consisted of average low-water surface elevations during the winter and average high-water surface elevations during the late spring and summer. Wetlands, along the reservoir shoreline dependent upon the reservoirs for part or all of their hydrology, would experience the same range of variation as under Current Operations. Implementation of the Proposed Action is not expected to change the characteristics of wetlands surrounding the reservoirs relative to the current condition. Fluctuation zone wetlands may be modified slightly in terms of distribution within Baker Lake as a result of more gradual fall drawdown rates.

No wetland habitats are expected to be affected by construction work on the new auxiliary powerhouse at the Lower Baker Development. Implementation of aquatic measures would have the potential to affect small areas of wetland habitats, primarily within the reservoir drawdown zones. No wetlands identified as high value in the pre-licensing studies (Hamer Environmental, et al., 2004) are located in the immediate vicinity of any of the proposed aquatic facilities.

Implementation of terrestrial resource measures under the Proposed Action would increase protection and quality of wetland habitats in the project area and on acquired project lands. A substantial number of acres of wetlands are expected to be acquired and enhanced. Quality of wetland habitats would be improved through enhancement measures, including management of noxious weeds, as prescribed under Proposed Article 508.

**Rare Plants**

No data regarding the occurrence of historical rare plant populations in the Baker River basin are available. Timber harvest and associated road construction on private, state, and federal lands in the basin likely affected rare plant habitats and populations over the last century. The original construction of the Baker River Project and inundation of the project reservoirs may have contributed to cumulative effects on rare plant species. The Forest Service estimates that project construction affected potential habitat for 13 sensitive species, although no direct evidence for the occurrence of the plants exists (Forest Service, 2003a).

Rare plants and state priority habitats occurring in the basin are protected to differing degrees by federal, Forest Service, and state regulations and policy. Protections are strongest for federally listed species, none of which have been documented in or near the project area. These protections are expected to continue in the future.

The Proposed Action would cumulatively contribute to the maintenance of rare plant populations through acquisition and protection of forested, wetland, and aquatic riparian habitats as specified in proposed articles 502 and 504. A specific program designed to protect special status plants, including survey, site-specific management plans, and monitoring, would be implemented under proposed articles 509 and 510. Potential rare plant habitat would be protected by controlling the spread of noxious weeds under Proposed Article 508.

Habitat-disturbing activities associated with the project would be evaluated for effects on rare plants, and appropriate protection or mitigation actions would be implemented under Proposed Article 509.

### 3.3.6 Federally Listed Threatened and Endangered Species and Essential Fish Habitat

By letters dated March 5, 2001, the Commission designated Puget to be its non-federal representative for consultation with NMFS and FWS pursuant to section 7 of the ESA. A list of federally listed endangered, threatened, proposed, and candidate species that may occur in the Baker River Project area was compiled by consulting the FWS and

NMFS electronic species list websites (FWS, 2004a; NMFS, 2004b). Critical habitat designations for listed fish species were obtained from NMFS (2005) and FWS (2005). Table 3-26 shows federally listed, proposed, and candidate fish and wildlife species known or potentially occurring in the project vicinity and indicates whether critical habitat or Essential Fish Habitat (EFH) has been designated for each listed species.

Table 3-26. Federally listed threatened, endangered, proposed, and candidate species known or potentially occurring in the Baker River Project vicinity.

| Common Name | Scientific Name | Federal Status | Occurrence in Baker River Basin | Critical Habitat or EFH |
|---|---|---|---|---|
| **Plants** | | | | |
| Golden paintbrush | *Castilleja levisecta* | Threatened | Historical record in Skagit County[a] | N/A |
| **Fish** | | | | |
| Chinook salmon | *Oncorhynchus tshawytscha* | Threatened | Documented in project area[b] | Critical habitat designated for mainstem Skagit River and select tributaries; Baker River not designated in final rule. EFH: Baker and Skagit Rivers[c] |
| Bull trout | *Salvelinus confluentus* | Threatened | Documented in project area[a] | Critical habitat designated for the mainstem Baker River and select tributaries. The project reservoirs are excluded[d] |
| Coho salmon | *Oncorhynchus kisutch* | Species of Concern | Documented in project area[b] | EFH: Baker and Skagit Rivers[c] |
| Pink Salmon | *Oncorhynchus gorbuscha* | Listing not warranted | Documented in project area[b] | EFH: Baker and Skagit Rivers[c] |
| **Amphibians** | | | | |
| Oregon spotted frog | *Rana pretiosa* | Candidate | Not observed during surveys of potential habitat[e] | N/A |
| **Birds** | | | | |

| Common Name | Scientific Name | Federal Status | Occurrence in Baker River Basin | Critical Habitat or EFH |
|---|---|---|---|---|
| Bald eagle | *Haliaeetus leucocephalus* | Threatened (proposed for delisting) | Documented; wintering, breeding territories on Baker Lake, Lake Shannon[a,f,g] | N/A |
| Marbled murrelet | *Brachyramphus marmoratus* | Threatened | Documented; present during breeding season[a,g] | Critical habitat designated in Baker River basin |
| Northern spotted owl | *Strix occidentalis spp. caurina* | Threatened | Documented; resident[a,g] | Critical habitat designated in Baker River basin |
| Yellow-billed cuckoo | *Coccyzus americanus* | Candidate | Not present within Baker River basin | N/A |
| **Mammals** | | | | |
| Canada lynx | *Lynx canadensis* | Threatened | Suspected; transient only | N/A |
| Fisher | *Martes pennanti* | Candidate | Documented in region historically; likely extirpated[h] | N/A |
| Gray wolf | *Canis lupus* | Threatened | Two recent sightings Baker River basin | N/A |
| Grizzly bear | *Ursus arctos* | Threatened | Documented; two recent sightings Upper Baker River basin; two recent sightings with tracks Baker Lake basin[g,i] | N/A |

| Common Name | Scientific Name | Federal Status | Occurrence in Baker River Basin | Critical Habitat or EFH |
|---|---|---|---|---|

[a] Berg (2004).
[b] Puget (2002b).
[c] Amendment No. 14 to the Pacific Coast Salmon Plan. Pacific Fisheries Management Council, Portland, OR. August 1999.
[d] FWS (2005).
[e] Hamer Environmental (2002a), Hamer Environmental and R2 (2003d).
[f] Puget (2002f).
[g] WDFW (2004).
[h] Lewis and Stinson (1998).
[i] Forest Service (2002a).

### 3.3.6.1 Affected Environment

***Aquatic Resources***

**Chinook Salmon**

Chinook salmon are the largest of all Pacific salmon. Chinook salmon, the least abundant of the five Pacific salmon species, were historically found from the Ventura River, California, to Point Hope, Alaska (Myers et al., 1998). Currently, spawning populations of Chinook exist from the San Joaquin River to the Kotzebue Sound, Alaska (Healey, 1991).

NMFS listed the Puget Sound Chinook salmon ESU as threatened under the ESA in March 1999 (64 FR 14308). Myers et al. (1998) cited contributing factors such as the degradation or loss of freshwater spawning and rearing habitat, variations in ocean conditions, poor hatchery practices, and substantial overharvest for the decline of Puget Sound Chinook. The Puget Sound ESU encompasses Chinook populations (both naturally spawning and hatchery populations) from the Elwha River on the Olympic Peninsula to the Nooksack River in North Puget Sound and south to the Nisqually River. However, of the 38 hatchery populations within the ESU, including Skagit (Marblemount) Hatchery populations, only five of the hatchery Chinook salmon stocks are protected under the ESA. The listed hatchery stocks are Kendall Creek, North Fork Stillaguamish, White River, Dungeness River, and Elwha River.

In February 2002, NMFS received several petitions to delist ESUs of Pacific salmon that are currently listed as threatened or endangered. The ESUs at issue were those that have hatchery populations that were excluded from ESA protection at the time of listing. The Puget Sound Chinook salmon ESU was included in the petitions for delisting. NMFS found that the petitioned actions might be warranted in view of a recent

U.S. District Court ruling regarding NMFS' prior treatment of hatchery fish in ESA-listing determinations. NMFS reviewed its policy regarding the consideration of hatchery fish in ESA status reviews. On June 14, 2004, NMFS proposed to expand the Puget Sound Chinook ESU to include 22 artificial propagation programs (i.e., hatcheries), including fall, spring yearling, spring subyearling, and summer run Chinook produced at the Marblemount Hatchery in the Skagit River basin.

NMFS designated critical habitat for the Puget Sound Chinook salmon ESU on February 16, 2000, which included the Baker River watershed (65 FR 7764). This designation was vacated and remanded to NMFS for new rulemaking consistent with all applicable federal laws. On December 14, 2004, NMFS proposed critical habitat designations for Puget Sound Chinook salmon and 12 other listed salmonid species (50 CFR Part 226). On September 2, 2005, NMFS designated critical habitat for the Puget Sound Chinook salmon ESU (NMFS, 2005). The Skagit River from the Baker River confluence downstream to the estuary was included in the designation. The Baker River watershed was not identified as critical habitat for the Puget Sound Chinook salmon ESU in the final rule.

The Skagit River supports the largest natural run of Chinook salmon in Puget Sound (WDFW and WWTIT, 1994; Cramer et al., 1999), which comprises three spring runs (Upper Sauk, Suiattle, and Upper Cascade), two summer runs (Upper Skagit mainstem/tributaries and Lower Sauk), and one fall run (Lower Skagit mainstem/tributaries). The vast majority of Skagit River Chinook salmon spawn in the Skagit River system upstream of the influence of the Baker River Project.

Historically, the Baker River Chinook run made up a small proportion of the total Skagit River Chinook run. When the Baker River trap was initially operated, an average of 157 Chinook returned to the trap from 1926–1933. These figures may be complicated by construction impacts on the Baker River Project from 1924–1927. An average of 222 Chinook salmon have returned to the Baker River trap from 1926–2003, with a high return of 1,453 fish in 1967 and a low of 1 Chinook in 1955. See section 3.3.4.1 for a detailed description of Chinook abundance and life history strategies in the project area.

Current fisheries management of the Baker River system is based on the assumption that if there was an original Baker River Chinook stock that was independent of the Skagit River stocks, it has been extirpated. The WDFW modified the procedure for handling the Baker River trap beginning in 1995, reducing the transport of Chinook into the Baker River system. WDFW decided adult Chinook entering the trap would have higher reproductive potential if they were returned to the Skagit River, as opposed to being transported to Baker Lake. In 1999, WDFW began introducing spring Chinook with an early adult migration pattern into the Baker watershed. In 1999, 2,000 excess

adult hatchery spring Chinook from Marblemount Hatchery were released into the reservoir above Upper Baker dam. Currently only unmarked Chinook that enter the Lower Baker River trap facility before August 15, or marked fish that enter the trap before September 1, are transported to Baker Lake. In 2004, this policy resulted in only 46 adult Chinook being released into Baker Lake (see section 3.3.4.1 for additional information about Chinook distribution in the project area).

In recent years, Skagit River adult Chinook escapement has frequently been below the goals of 14,900 fall/summer Chinook and 3,000 spring Chinook adults (WDFW and WWTIT, 1994). Because of these declines, WDFW considers the fall Chinook run that inhabits the Lower Skagit River to be depressed.

Potential strategies for restoring Chinook salmon populations to the Skagit River System are currently under development. Section 4(f) of the ESA mandates that a recovery plan be drafted for listed species. Recovery plans describe actions considered necessary for the conservation and recovery of species listed under the ESA. The Skagit Chinook Workgroup, an association formed by agency representatives with interests in the basin, was created to guide the preparation of a Chinook salmon recovery plan for the Skagit River basin. When completed, this plan will outline recovery and management objectives for Chinook in the entire Skagit River basin, including the Baker River and the Skagit River below the Baker River confluence.

On December 27, 2005, NMFS announced the availability for public review of a proposed Puget Sound Salmon Recovery Plan for the Puget Sound Chinook Salmon ESU (Shared Strategy for Puget Sound, 2005). The Plan consists of a Draft Puget Sound Recovery Plan prepared by the Shared Strategy and a NMFS supplement to the Shared Strategy Plan. The NMFS is soliciting review and comment on the proposed Plan from the public and all interested parties.

**Bull Trout**

Bull trout are native to most of the interior and some coastal drainages of the Pacific Northwest (63 FR 31693). Populations of bull trout are found in western Washington, including coastal drainages of the Puget Sound, Straight of Juan de Fuca, Hood Canal, and Olympic Peninsula (64 FR 58910). Bull trout have been recorded in northern California and Nevada; the Klamath River basin in Oregon; throughout much of interior Oregon, Washington, Idaho, and western Montana; and British Columbia, Hudson Bay, and the St. Mary's River Saskatchewan; but are shrinking in distribution throughout their former range (63 FR 31693).

The FWS received a petition from an alliance of conservation organizations in Montana to list bull trout throughout its native range under the ESA on October 30, 1992.

In 1994, the FWS determined that listing was warranted within the coterminous United States but was precluded due to the need to list higher priority species. Legal debate followed the warranted-but-precluded status from 1995–1997 until populations in the Columbia River, Klamath River, and Jarbidge River basins were listed in June 1998. On November 1, 1999, the FWS issued a final rule announcing the listing of bull trout throughout the coterminous United States as a threatened species under the ESA (64 FR 58910).

The Coastal-Puget Sound DPS encompasses all Pacific Coast drainages within the coterminous United States north of the Columbia River and includes 34 "subpopulations" of native char, 15 of which occur in the Puget Sound analysis area, and four that occur in the Skagit River basin. The Skagit River basin supports the largest population of native char in Puget Sound. Anadromous, adfluvial, and riverine life history strategies all exist in the watershed, and there is considerable geographical overlap between fish exhibiting different life history patterns. WDFW originally classified bull trout within the Baker River basin reservoirs and tributaries as a distinct stock based on its geographic distribution (WDFW, 1998) and classified the status as "unknown." However, the Bull Trout Recovery Team reviewed the distribution of Skagit River basin subpopulations, and bull trout within the Baker River basin are now considered to be part of the Lower Skagit River subpopulation (Hilgret, 2002). The Lower Skagit River bull trout subpopulation is the only one considered "strong" by the FWS in the Puget Sound analysis area, based on the large number of spawning adults and high overall abundance (64 FR 58910). The status of the other three subpopulations in the Skagit River is "unknown" because insufficient abundance, trend, and life history information is available.

At the time of bull trout listing, the FWS did not list Dolly Varden as a threatened species. In 2001, the FWS proposed that the species be afforded protection under the similarity of appearance provisions of ESA (66 FR 1628). The FWS has not made a final decision on the Dolly Varden proposal.

The FWS proposed designating critical habitat for Coastal-Puget Sound bull trout on June 24, 2004 (50 CFR Part 17). On September 26, 2005, the FWS designated critical habitat for the Coastal-Puget Sound bull trout DPS. The mainstem Baker River and select tributaries were designated as bull trout critical habitat, Baker Lake and Lake Shannon were excluded from the designation (FWS, 2005).

Bull trout have very specific habitat requirements and are more sensitive to habitat changes than other Pacific salmonid species. In the listing of bull trout, the FWS addressed numerous factors that have contributed to the depletion of bull trout populations, including: (1) the destruction and modification of bull trout habitat through

effects from dams, forest practices, livestock grazing, agriculture, roads, and mining; (2) overharvest of bull trout for commercial and recreational fishing; and (3) inadequacy of existing regulatory mechanisms (63 FR 31693). In addition, bull trout may interbreed with non-native brook trout, which may compromise bull trout production where brook trout are present (FWS, 1998).

Native char in Puget Sound and coastal streams may express up to four life history types: anadromous, adfluvial, fluvial, and resident. Anadromous forms migrate to marine areas in the spring and return in late summer and early fall (Wydoski and Whitney, 2003). Anadromous native char may spend 2 or 3 years in freshwater before migrating to sea. Little is known about their habits or distribution while in the marine environment. Adfluvial stocks rear in lakes or reservoirs before returning to tributary streams to spawn. Fluvial bull trout may migrate between natal streams and larger river systems, while resident bull trout complete their life cycles within natal streams. Individual fish may exhibit changes in life history type in response to changes in environmental conditions. A recent study using scale analysis to back-calculate length-at-age and age-at-spawning indicates that individual fish in the Skagit River basin may switch life histories (either from resident to anadromous or from anadromous to resident), and may also spawn at each stage (Kraemer, 2003).

The Baker River supports at least adfluvial and resident bull trout life histories. It is uncertain whether anadromous or fluvial bull trout inhabit the Baker River. Each year, adult bull trout are observed at the Lower Baker River trap. Formal records of adult captures at the trap were not kept until 1994, and since that time, an average of 19 bull trout have been collected at the Lower Baker trap and released into Baker Lake. Small numbers of juvenile bull trout have been captured at the downstream fish passage facilities at Baker Lake and Lake Shannon, but little is known about bull trout reproduction and movement in the Upper Baker River watershed. See section 3.3.4.1 for a detailed description of native char abundance and life history strategies in the Baker River basin.

**Coho Salmon**

As discussed in section 3.3.4.1, coho salmon are the most abundant anadromous salmonid species in the Baker River system. Baker River coho salmon are part of the Puget Sound/Strait of Georgia ESU. In response to petitions requesting listing of this coho ESU, NMFS reviewed Puget Sound/Straight of Georgia coho status in the early 1990s. On July 25, 1995, NMFS found that the ESU did not warrant listing as threatened or endangered. However, the status review reflected the overall health of the ESU, which prompted NMFS to designate the Puget Sound/Straight of Georgia coho salmon ESU as a Species of Concern (69 FR 19975). Candidate species are not required to be considered in section 7 consultation under the ESA. However, EFH provisions apply to coho salmon

in the Baker and Skagit rivers, as described below. Additional information pertaining to coho salmon in the Baker River system is provided in the Anadromous Fish Species discussion in section 3.3.4.1.

**Pink Salmon**

Pink salmon from the Skagit River System are part of the odd-year pink salmon ESU in Washington and southern British Columbia. NMFS reviewed the status of this ESU and ruled on October 4, 1995, that odd-year pink salmon were not currently at risk of extinction; therefore, no ESA listing of the species was proposed (60 FR 51928). EFH provisions apply to Puget Sound pink salmon, including those inhabiting the Skagit River System, as described below.

**Essential Fish Habitat**

The MSA, as amended by the Sustainable Fisheries Act of 1996 (PL 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. The MSA, as amended, defines EFH as those waters and substrate necessary for fish use in spawning, breeding, feeding, or growth to maturity. The MSA requires federal agencies to consult with NMFS regarding activities that may adversely affect EFH. The objectives of EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH. The implementing regulations for MSA allow for the integration of NEPA or ESA section 7 reviews with the analysis of proposed project effects on EFH. Therefore, the information contained in this draft EIS has been drafted in accordance with the EFH consultation requirements defined by NMFS.

Pursuant to the MSA, the Pacific Fisheries Management Council has designated EFH for Chinook, coho, and Puget Sound pink salmon. Freshwater EFH for coho and Chinook salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California. Freshwater EFH for pink salmon includes all currently or historically accessible waters in the Puget Sound region. The four major components of EFH for these species consist of (1) spawning and incubation, (2) juvenile rearing, (3) juvenile migration corridors, and (4) adult migration corridors and adult holding habitat.

EFH potentially affected by the project extends from the headwaters of the Baker River down to the confluence with the Skagit River, and the Skagit River below the confluence with the Baker River. The general habitat characteristics for these reaches are described in the discussion of Aquatic Habitat Conditions in section 3.3.4.1.

***Terrestrial Resources***

### Golden Paintbrush

Golden paintbrush was listed by the FWS as federally threatened on July 11, 1997 (62 FR 31740); it is designated as endangered in the State of Washington. The species is found in open grasslands of the Puget Trough ecoregion at elevations of less than 328 feet. Currently, populations in Washington are known from near Olympia, northern Whidbey Island, and the San Juan Islands (WNHP, 2004a). A single historical record from Skagit County is recorded in the WNHP database, and was reported by FWS (FWS species list for the Baker River Project, attachment to letter from K.S. Berg, Manager, Western Washington Fish and Wildlife Office, FWS, Olympia, WA, to K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, dated February 20, 2004). However, this occurrence was located outside of both the project area and the Baker River basin.

Golden paintbrush is not known or suspected to occur within the Baker River basin. The project area is outside the known historic distribution of the species, which is restricted to low elevation grasslands of the Puget Trough ecoregion.

### Oregon Spotted Frog

Oregon spotted frog is a candidate for federal listing and a Washington State endangered species. Four distinct populations of spotted frog were indicated to be warranted for listing in 1993, including the Pacific Coast population (58 FR 27260). Recently, the Pacific Coast population was determined to be a separate species.

Historically, Oregon spotted frog was present in the Puget Trough ecoregion lowlands from southern British Columbia to northern California and east into the Cascade Mountains in southern Washington and Oregon. Eleven historical populations in Washington have been documented; in 1930, one of these populations was reported two miles northwest of the Town of Concrete (McAllister and Leonard, 1997). This site may have been located at the extreme south end of the Baker River Project area. Suitable habitat for Oregon spotted frog may have been provided historically by wetlands and side channel habitat in the Skagit River valley, and possibly the Baker River drainage. Habitat loss, through modification of riparian and wetland habitat, is thought to be a major factor in the decline of the species throughout the state (McAllister and Leonard, 1997).

Currently, three populations of Oregon spotted frog are known in Washington State: one in south Puget Sound, and two in the Cascade Mountains of south-Central Washington (McAllister and Leonard, 1997). One population is known from British Columbia and another 20 populations are documented in Oregon.

Suitable habitat for Oregon spotted frogs is shallow, emergent wetlands, typically in forested areas. Oregon spotted frogs rarely leave the aquatic environment and are usually found in standing, shallow water with abundant emergent or floating vegetation.

Puget conducted a survey for spotted frogs during summer 2001 in the Baker River watershed (Hamer Environmental, 2002a). Surveys were conducted at a sample of wetlands and ponds (22 sites) considered "the best suitable habitat available in the Baker River watershed" (Hamer Environmental, 2002a). The WTRWG participated in the site selection process and the development of a sampling protocol.

Three types of survey methods were used: visual observations, dip netting, and funnel traps. The survey methods followed the Oregon spotted frog protocol that Applegarth (1994) described. No Oregon spotted frogs were detected during the 142 hours of surveys. Puget also conducted general amphibian surveys of Baker River Project reservoir areas in 2002 (Hamer Environmental and R2, 2003d); no Oregon spotted frogs were detected during these surveys.

**Bald Eagle**

In 1978, the bald eagle was federally listed throughout the lower 48 states as endangered, except in Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was listed as threatened (43 FR 6233). Five recovery regions were established; the Pacific region published a recovery plan in 1986 (FWS, 1986). The bald eagle is currently classified as a threatened species by the State of Washington. Reasons for the decline in bald eagle populations included trophy hunting, poisoning of livestock predators, habitat loss, human disturbance, and bioaccumulation effects of DDT and other organochlorine compounds.

The bald eagle population has shown dramatic recovery from its estimated low of 417 pairs in the lower 48 states in 1963; in July 1999, the number of nesting pairs was estimated at 5,748 (Stinson et al., 2001). By 1995, declassification goals had been achieved in states where the bald eagle was listed as endangered, and the species was downlisted to threatened in all of the lower 48 states (60 FR 35999). In 1999, the bald eagle was proposed for removal from the list of threatened and endangered species, as recovery goals had generally been met or exceeded throughout the range of the species in the coterminous states (64 FR 36543).

Washington State supports a large number of breeding and wintering bald eagles. Prior to European settlement, the summer population of bald eagles in the state may have been as high as 6,500 (Stinson et al., 2001). A low of 105 documented breeding pairs was recorded in 1980. Protection measures, elimination of DDT use, construction of major reservoirs (particularly in eastern Washington), and introduction of warm-water

fishes, all have likely contributed to the increase in both breeding and wintering eagles in the state over the past 20 years. In 1998, 664 occupied nests were recorded. Wintering eagles, largely from Canada and Alaska, have also increased in number. Surveys during the mid-1980s recorded 1,000 to 3,000 eagles in the state during the winter. Based on those trend data and on increases in breeding bird numbers, a total winter population of about 4,500 birds was predicted by the year 2000 (Stinson et al., 2001).

Bald eagles are both predators and scavengers, feeding largely on fish and waterfowl. Bald eagles select nesting sites near open-water bodies, including lakes, rivers, estuaries, and marine shorelines. In Washington, the breeding season extends from courtship and nest-building in January and February to fledging of the eaglets typically in mid-July (Watson and Roderick, 2002). Nest trees are selected by height, structure, and location, rather than by species; nests are typically re-used, although alternate nest sites may be present within a nesting territory.

Wintering eagles congregate in areas providing open water, food, perches, and suitable night roosts. During the day, perches are selected in proximity to food sources. Communal roosts are used at night and are typically situated in uneven-aged stands with multilayered canopies and in areas sheltered from winds (Watson and Roderick, 2002).

Primary limiting factors to wintering and breeding bald eagles in Washington State were summarized by Watson and Roderick (2002). Habitat alteration, including the removal of perch, roost, and nest trees; loss of buffer trees; and disturbance of magnitude sufficient to cause reproductive failure or reduced vigor are the most severe threats to bald eagles in Washington. Human activities near nest sites during the nesting season can disturb eagles leading to nest abandonment or reduced reproductive success (Anthony and Isaacs, 1989). Disturbance while feeding, particularly during winter, can cause eagles to expend more energy, increasing their susceptibility to disease and poor health (Stalmaster, 1987). Loss of food resources may be a limiting factor in areas where salmon populations have significantly declined.

Bald eagles use the Baker River basin for nesting, foraging, and overwintering. The project reservoirs support up to three pairs of breeding bald eagles each summer (Puget, 2002f; Puget, 2004c). Two nesting territories were documented in use at Baker Lake between 1991 and 2003. One territory is located near the outlet of the Baker River at the head of Baker Lake. A second territory is located near Boulder Creek and has included at least three different nest sites. During 2002, a third nest territory was occupied near Thunder Creek on Lake Shannon. Neither the Baker River nor the Boulder Creek territory was active during 2002, and the nest at the Baker River territory had blown out of the tree during the previous winter. One of the Baker Lake pairs may have shifted to the new territory at Lake Shannon during 2002. During 2004, three nest sites

were active at Baker Lake, including a new active site near the Maple Grove Campground (Puget, 2004c). The Thunder Creek territory at Lake Shannon was inactive during 2004.

Table 3-27 shows the number of bald eagle chicks observed at each nest territory during summer surveys between 1991 and 2004. Most of the surveys were conducted by boat, which provided incomplete viewing of the nests; therefore, it is possible that chicks were present but not counted during these surveys. Aerial surveys, which provide complete viewing of the nests, were conducted in 1992, 2000, 2001, 2003, and 2004. Surveys did not provide complete data on number of young fledged. Between 1991 and 2004, a total of 13 chicks were observed during eight seasons at the Baker River territory. During the same period, five chicks were observed in five seasons at the Boulder Creek nest territory. In three years of surveys at the new Thunder Creek nest territory on Lake Shannon, three chicks were observed during two nesting seasons. One egg (probably non-viable) was observed in the new nest at Maple Grove during 2004. This nest had been observed previously but had never been associated with actively nesting bald eagles (Puget, 2004c).

Table 3-27. Baker Lake Project bald eagle nest territory productivity 1991–2004. (Source: Puget, 2002f; Puget, 2004c)

| Survey Date | Survey Method | Baker River Nest Territory | Boulder Creek Nest Territory | Thunder Creek Nest Territory [a] | Maple Grove Nest Territory[b] |
|---|---|---|---|---|---|
| June 4 & 20, 1991 | Boat | 2 chicks | 1 chick | -- | -- |
| June 30, 1992 | Boat/aerial | Active[c] | No activity[d] | -- | -- |
| June 30, 1993 | Boat | 1 chick | 1 chick | -- | -- |
| July 20, 1994 | Boat | 2 chicks | No activity | -- | -- |
| July 11, 1995 | Boat | 2 chicks | Active | -- | -- |
| July 17, 1996 | Boat | 1 chick | 1 chick | -- | -- |
| June 24, 1997 | Boat | Active | No activity | -- | -- |
| June 23, 1998 | Boat | No activity | No activity | -- | -- |
| August 6, 1999 | Boat | 1 chick | No activity | -- | -- |
| July 12, 2000 | Aerial | 1 chick | No activity | -- | -- |
| July 5, 2001 | Aerial | 1 chick | 1 chick | -- | -- |
| July 16, 2002 | Boat | No activity | No activity | 1 chick | -- |
| July 8, 2003 | Aerial | Active | No activity | 2 chicks | -- |
| July 12, 2004 | Aerial | 2 chicks | 1 chick | No activity | Active; one |

| Survey Date | Survey Method | Baker River Nest Territory | Boulder Creek Nest Territory | Thunder Creek Nest Territory [a] | Maple Grove Nest Territory[b] |
|---|---|---|---|---|---|
| | | | | | egg |

[a] Thunder Creek nest first observed in 2002.
[b] Maple Grove nest first observed active in 2004.
[c] "Active" indicates adult bald eagles (but no chicks) observed at or near nest on survey date.
[d] "No activity" indicates no bald eagles (adults, juveniles, or chicks) observed at or near nest on survey date.

It is not known whether bald eagles nested along the Baker River prior to construction of the project reservoirs. Spawning summer steelhead and sockeye would have provided a food source during the nesting season (Forest Service, 2002b; table 3-13). The reservoirs may have improved the quality of breeding habitat for bald eagles by creating a more dependable summer food source of fish and waterfowl; however, no specific data are available to verify this assumption. The nearest active bald eagle nest site outside of the project vicinity is located on the Skagit River downstream of the Baker River confluence (letter from K.S. Berg, Manager, Western Washington Fish and Wildlife Office, FWS, Olympia, WA, to K. Smayda, Biologist, Smayda Environmental Associates, Inc., Seattle, WA, dated February 13, 2003; WDFW, 2004).

No estimates of bald eagle winter use of the Baker River prior to construction of the project are available. Coho, Chinook, pink, and chum salmon and winter steelhead trout would have provided a potential food resource for wintering bald eagles, with adult runs extending primarily from August through December. Anadromous coastal cutthroat trout would also have been present.

Wintering bald eagles concentrate along the Skagit River from September to January to feed on salmon carcasses. Suitable wintering areas provide large, late-run salmon populations and/or abundant waterfowl. The Skagit River attracts a high number of bald eagles that feed primarily on chum but also coho and steelhead (Stinson et al., 2001). Winter bald eagle distribution and abundance along the Skagit River is highly associated with chum salmon abundance. Currently, mainstream Skagit River fall chum stocks are healthy and production levels are consistent with available habitat (WDFW and WWTIT, 1994).

In late winter, bald eagles move from the Skagit River to its tributaries to feed on late spawning coho salmon (Forest Service, 2002a). Puget survey data from 1992 to 2002 show the average number of bald eagle sightings on Lake Shannon increasing

during December and January, and peaking during February (Puget, 2002f). Baker Lake data from the same period indicate peak bald eagle numbers in January. The greatest number of bald eagles recorded on a single survey date was 32 for Lake Shannon (24 adults and 8 juveniles) recorded on February 21, 1996. Baker Lake surveys showed a maximum number of eagles on January 1, 1992, with a total of 18 eagles (16 adults, 2 juveniles).

Bald eagles may roost communally near feeding areas during the winter. Roost sites are often located in mature or old-growth forest stands in proximity to feeding areas. There are no known night roosts in the immediate vicinity of the Baker River Project; however, potential communal night roost habitat is available in the basin (Puget, 2002b). A total of 3 bald eagle communal night roosts have been documented on the Skagit River within 2 miles of the mouth of the Baker River (WDFW, 2004).

Puget and the Forest Service have implemented protection measures at the bald eagle nest territory located at the upper end of Baker Lake to reduce the potential for human disturbance. An access road leading through the nesting territory is closed seasonally, and the area has been signed to inform visitors of the sensitive wildlife habitat behind the closed road.

Both federal and state regulations, which include the ESA, Bald and Golden Eagle Protection Acts, the Migratory Bird Treaty Act, and the state ESA, protect bald eagles and their nest sites. Washington State management recommendations for bald eagles include separate guidelines for nest tree, winter roost, and perching/feeding area protection (Watson and Roderick, 2002). In the event that the bald eagle is delisted, many of these protections will remain in effect. The FWS will continue to monitor bald eagle populations for at least 5 years (64 FR 36453). The Forest Service intends to designate the bald eagle a sensitive species (FO, 2002a). The State of Washington will initiate a review of the state status of the species at the time of federal delisting; currently, the State of Washington recommends that the bald eagle be down-listed to state sensitive, rather than removed from the list, based on development trends in areas affecting bald eagle habitat (Stinson et al., 2001).

### Marbled Murrelet

The marbled murrelet was designated as federally threatened in Washington, Oregon, and California on October 1, 1992 (57 FR 45328); it is also a Washington State threatened species. Critical habitat was designated for the species in 1996 (61 FR 26255) and a recovery plan was adopted in 1997 (FWS, 1997). The FWS 5-year review concluded that the 1992 final listing as threatened will remain in effect until a range-wide status review of the species can be conducted (FWS, 2004a).

The marbled murrelet is a small seabird that feeds on marine waters but nests high in the canopy of old-growth coniferous forests. They commonly occupy large stands (500 acres) rather than smaller stands (100 acres) and are typically absent from stands less than 60 acres (FWS, 2004c). Large diameter trees with large diameter limbs, broken tops, witches' brooms, or other deformities are used for nest platforms; nests are not constructed but usually are located on a substrate of moss or lichen. The breeding season extends from April 1 to September 15.

Adult murrelets carry food from marine waters to the single offspring at the nest site, flying distances as great as 52 miles inland (Ralph et al., 1994). Pacific sand lance is the primary prey species of marbled murrelets, constituting more than 65 percent of their diet, especially during the breeding season (Burkett, 1995). Other prey species include Pacific herring, sea perch, euphausiids, and other marine invertebrates (Burkett, 1995).

Factors that contributed to the decline in marbled murrelet populations included over-fishing of its prey species, entanglement in fishing nets, oil spills, and loss of nesting habitat through timber harvest and development (WDFW, 1993). Potential threats to marbled murrelet populations include loss of old-growth forest, disturbance during nesting, nest predation, oil spills, entanglement in gill-nets, and disturbance during foraging (Ralph et al., 1995).

Recent population estimates for Washington State indicated approximately 5,500 murrelets (Ralph et al., 1995). Modeling for the Pacific Northwest population predicts an annual decline of 2 to 12 percent of the at-sea population of murrelets (Corps, 2000). An evaluation report of the marbled murrelet was prepared for the FWS in 2004 (EDAW, 2004a). The report concludes that although the rate of population decline has been reduced, the listed population is expected to continue to decline during the next 40 years. Critical habitat was designated for the marbled murrelet to provide suitable nesting habitat, located in proximity to marine foraging habitat, on lands not otherwise protected by existing regulations or land use designation. Most known nest sites were included in critical habitat designations, on both federal and private land. National Parks, Wilderness Areas, and National Wildlife Refuges were generally excluded from critical habitat designation. In the Baker River Project vicinity, critical habitat for marbled murrelet coincides with LSRs designated under the Northwest Forest Plan (Forest Service and BLM, 1994a) created for the management of northern spotted owl and other old-growth species. The Baker LSR is about 82,100 acres in size, and is adjacent to the Mt. Baker and Noisy-Diobsud wilderness, the Mt. Baker National Recreation Area, and the North Cascades National Park, each of which may provide additional suitable habitat. Murrelets generally use forest stands in the western hemlock and silver fir vegetation zones located below 3,200 feet elevation.

Surveys of the Baker River basin have documented marbled murrelets present during the nesting season, and presumably nesting. Forest Service surveys indicate that the northern half of the Mt. Baker-Snoqualmie National Forest accounts for 50 percent of nesting habitat and 85 percent of murrelet detections on the entire forest (Forest Service, 2002a). The WDFW priority habitats and species database shows 10 "occupancy" sites in or near the watershed, where occupancy is determined by the detection of flying behaviors and/or vocalizations believed to be associated with nesting (WDFW, 2004). Four of these sites are located along Park Creek, well upstream of Baker Lake. Four occupancy sites are located along Anderson Creek, near the mouth and upstream. Two occupancy sites are located south of Thunder Creek, well upstream of Lake Shannon; one of these sites is outside the Baker watershed. Surveys were performed for a number of small hydroelectric projects proposed for Anderson and Park creeks on Baker Lake during the early 1990s in conjunction with the Forest Service (Beak, 1992a, 1992b). Occupancy was determined at three of six sites at Anderson Creek (southeastern side of Baker Lake) during 1992. At Park Creek, on the northwestern side of Baker Lake, occupancy was determined at four of eight sites in 1992. Surveys have not been conducted in recent years, and the current status of marbled murrelets in the basin is unknown.

At this time, most suitable marbled murrelet habitat in the Baker River basin is protected by designation as LSR, within which timber harvest is restricted, or by other federal land use designation. Small amounts of suitable habitat may be present on privately owned timberlands.

**Northern Spotted Owl**

The northern spotted owl was federally listed as threatened in Washington, Oregon, and California in July 1990 (55 FR 26114); it is a Washington State endangered species. Factors that contributed to the federal listing were the declining population trends, the loss of suitable forested habitats throughout the species range, and the lack of adequate regulatory mechanisms to protect existing habitat for the species. Critical habitat was designated for the northern spotted owl in 1992 (57 FR 1796). The FWS 5-year review of the northern spotted owl concluded that the species will remain listed as threatened (FWS, 2004d).

Spotted owls are strongly associated with mature and old-growth forests for nesting, foraging, and roosting. Nesting and roosting occur in a variety of coniferous forest types characterized by moderate to high levels of canopy closure; high density of standing snags; large diameter overstory trees with deformities, such as broken tops and witches' brooms; and abundant coarse woody debris on the forest floor (FWS, 1987a). Foraging occurs in nesting and roosting habitat, and in coniferous forest of younger age and less structural diversity, where key prey species are present. Important forage

species in mesic Douglas fir forests include northern flying squirrel and woodrat species; these species occur at relatively low density and the spotted owl has a correspondingly large home range (FWS, 1992).

A final draft recovery plan for the spotted owl was prepared in 1992 (FWS, 1992); the plan was never formally adopted. Critical habitat for spotted owls in the Baker River basin is located on National Forest System lands surrounding Baker Lake. Congressionally reserved areas, including Wilderness and National Recreation Areas, are excluded from the critical habitat designation. The Northwest Forest Plan (Forest Service and BLM, 1994a) serves recovery plan functions through specific management requirements, standards, and guidelines. The Northwest Forest Plan established a system of LSRs to provide habitat capable of supporting viable populations of species associated with late- and old-successional forest, including the northern spotted owl and marbled murrelet. The Baker LSR is about 82,100 acres and almost completely surrounds Baker Lake. DCA WD-21 was established in 1992 for the protection of northern spotted owls (FWS, 1992) and contributes another 29,750 acres of protected lands. Additional habitat that may be suitable for spotted owl is located in adjacent wilderness areas, the Mt. Baker National Recreation Area, and the North Cascades National Park.

The Baker LSR and DCA WD-21 combined are projected to support 28 pairs of nesting spotted owls (Forest Service, 2002a). The Baker LSR/DCA is expected to be a major contributor to spotted owl recovery as a source of owls dispersing to the north, southeast, south, and east. The Forest Service (2002a) analyzed habitat suitability for spotted owl within the LSR/DCA. Approximately 67 percent of the area is in the western hemlock and Pacific silver fir vegetation zones; the remaining 33 percent is in the mountain hemlock or non-forested zones, which do not provide spotted owl habitat. Only 17 percent of the LSR/DCA is in the western hemlock zone, which is the lowest elevation, highest productivity forest. Approximately 70 percent of the LSR/DCA is late- and old-successional forest; about one-third of this amount is greater than 450 years old and provides optimum habitat for old-growth associated species.

The size of old-growth stands is also important to the quality of spotted owl habitat. Throughout the Baker LSR, most patches of late successional and old-growth forest are greater than 620 acres. Old-growth forest has been fragmented into smaller blocks in the Rocky, Sandy, and Dillard creek drainages.

Spotted owl surveys were conducted in the Anderson and Park creek drainages on Baker Lake during the late 1980s and early 1990s. Reproductive pairs of spotted owls were located in Anderson Creek during 1989, 1991, and 1992 (Beak, 1992c). Adult owls were located on Park Creek during the same years; however, reproductive status was not determined (Beak, 1992d). Pairs of owls were also recorded in the Swift, Shuksan, Little

Sandy, Sandy, and Noisy creek drainages between 1989 and 1992 (WDFW, 2004). The NPS surveyed owls in the North Cascades National Park from 1993 through 1996 (Kuntz and Christopherson, 1996). A total of six spotted owl pairs and five single owls were located in the Park, which is located partially within the Baker River basin. WDFW data on priority habitats and species indicate eight spotted owl site centers within the Baker River watershed (WDFW, 2004). Activity at these sites has not been verified in recent years, and the current status of the spotted owl population in the Baker River basin is largely unknown.

Currently, spotted owls and their habitat are protected by the requirements of the Northwest Forest Plan, as well as the ESA and Migratory Bird Treaty Act. Timber harvest on private lands is performed under the Washington State Forest Practices Act, which incorporates assessment of effects to listed species.

**Yellow-billed Cuckoo**

Yellow-billed cuckoo was designated a federal candidate species on July 18, 2001 (66 FR 38611). The FWS concluded that listing of the species as threatened is warranted, but precluded by higher priority listing actions.

Based on historical accounts, yellow-billed cuckoo (*Coccyzus americanus*) was once locally common in Washington (Laymon, 2000; 66 FR 38611). The last confirmed breeding records of this neotropical migrant in Washington were in the 1930s, and the species is now believed to be extirpated from the state. Occasional summer visitors have been recorded in Washington. In the west, yellow-billed cuckoo is closely tied to deciduous riparian habitat, particularly cottonwood-willow associations (Laymon, 2000). Loss and degradation of deciduous riparian habitats in the western United States appears to be a primary factor in the decline of the species. Overgrazing, displacement of favorable vegetation by alien plants, river water management, logging, and pesticides are the primary causes of habitat degradation.

Yellow-billed cuckoo is not known or suspected to breed in the Baker River basin, and no records of incidental sightings are recorded in the WDFW Priority Species and Habitats database (WDFW, 2004).

**Canada Lynx**

The Canada lynx was listed as federally threatened in the 48 contiguous states on April 23, 2000 (63 FR 36994). A lynx recovery plan was published by the WDFW in March 2001 (Stinson, 2001). Primary reasons lynx populations are in decline include alteration of habitat, overhunting, disturbance by humans, and competition with species, such as bobcat and coyotes, which have expanded their ranges (63 FR 36994). The lynx

was designated a Washington State threatened species on November 14, 1993 (Stinson, 2001).

Lynx are found mainly in the north central and northeastern portions of Washington State. In the Cascades, lynx inhabit primarily high-elevation forests with a strong component of subalpine fir (McKelvey et al., 1999; Stinson, 2001). Lynx populations are strongly correlated with snowshoe hare populations; high-quality foraging habitat occurs in early successional forest stands with high densities of hare. Thermal and security cover and denning habitat are provided by mature, closed canopy forests (Stinson, 2001). The Washington State population of Canada lynx is currently estimated at fewer than 100 individuals (Stinson, 2001).

The lynx is neither known nor suspected to be a resident in the Baker River watershed (Forest Service, 2002a; Stinson, 2001). Based on Forest Service modeling of lynx habitat, no potential habitat is thought to be present in the Baker River watershed. Hair-snagging surveys performed in 1998 in the Rocky and Sulphur creek drainages did not detect the presence of lynx (Forest Service, 2002a). It is possible that transient lynx, dispersing from eastern Washington habitats, pass through the Baker River watershed on occasion (Forest Service, 2002a).

Six Lynx Management Zones have been established in areas that are occupied, or were recently occupied, by lynx (Stinson, 2001). The Baker River Project area is outside of the Lynx Management Zones, which are located mainly east of the Cascade crest.

**Fisher**

The West Coast DPS of the fisher was designated a candidate for federal listing in April 2004 (69 FR 18769). This population segment includes portions of California, Oregon, and Washington. The FWS concluded that listing of the West Coast DPS is warranted, but precluded by higher priority listing actions. Fisher is classified as endangered in Washington State and is designated as a Region 6 sensitive species by the Forest Serivce. A status report for the fisher was prepared for the State of Washington in 1998 (Lewis and Stinson, 1998).

Fishers inhabit coniferous and mixed deciduous/coniferous forests with closed canopies and large diameter snags and logs. They use riparian zones, lakeshores, and ridges, often maintaining very large home ranges for foraging. Formerly occupying forested habitats in the northern United States and Canada, the fisher's range has been reduced due to loss and modification of forested habitats, predator and pest control efforts, and trapping (Lewis and Stinson, 1998; 69 FR 18769). Since the 1950s, fisher populations have recovered in some areas of the eastern United States and Canada likely

because of regeneration of forest habitats from farmlands, cessation of trapping, and reintroduction.

Fisher historically occurred throughout much of the forested area of Washington, including the Olympic Peninsula, Cascade Mountains, and probably southwestern and northeastern portions of the state (Lewis and Stinson, 1998). The species is not believed to have been abundant (Lewis and Stinson, 1998). Based on Lewis and Stinson's 1998 Status Report, only three verifiable records, involving trapped specimens or photos, were recorded in the state between 1992 and 1998. The fisher is very rare and probably not represented by a viable population in Washington State (Lewis and Stinson, 1998). The species currently is thought to be extirpated from the state (Lewis and Hayes, 2004).

A total of 12 sightings or recordings of tracks, of various levels of reliability, were documented at sites in Skagit and Whatcom counties between 1939 and 1995 (Lewis and Stinson, 1998). The WDFW priority habitats and species database does not include any reports of fisher sightings in the Baker River watershed (WDFW, 2004). Fisher may occur in the watershed as suitable habitat is present; however, no populations of fisher are known or suspected to be present.

**Gray Wolf**

In 1978, the gray wolf was listed as endangered throughout the 48 coterminous states, except Minnesota, where it was listed as threatened (43 FR 9607). Critical habitat for the species was designated within the states of Michigan and Minnesota in the same ruling. On April 1, 2003, three DPSs for the gray wolf were established: the Western DPS, Eastern DPS, and Southwestern DPS (68 FR 15803). This ruling also reclassified the gray wolf from endangered to threatened within the Western DPS and Eastern DPS (except where already classified as threatened or as an experimental population). The Western DPS includes all of Montana, Wyoming, and Idaho, along with Washington, Oregon, California, Nevada, northern Colorado, and northern Utah. Gray wolves are also classified as endangered by the State of Washington.

Gray wolves previously occupied most of the lower 48 states. Their populations declined with increased populations of European settlers across the mid-west and western states. Wolves were hunted for their furs and were killed in great numbers as part of predator control programs. They were extirpated from most of the lower 48 states, early in the twentieth century, although a small population remained in Minnesota.

The Northern Rocky Mountain Wolf Recovery Plan was published in 1980 and revised in 1987 (FWS, 1980, 1987b). This plan included all of Washington State; however, specific population goals for the state were not included. Recovery in the Rocky Mountain area relied on two reintroduced, experimental populations in central

Idaho and Yellowstone National Park, and one site in Glacier National Park, Montana, that was reoccupied by wolves from Canada. At this time, the recovery criteria set in the 1987 plan have been exceeded, and the three individual populations are believed to be acting as a metapopulation. The FWS intends to propose to delist the wolf in the Western DPS in the near future (50 FR 15879).

A small population of gray wolves may be present in the North Cascades Mountains of Washington (WDFW, 2003a). Wolves have been seen regularly in southern British Columbia north of the North Cascades National Park and Ross Lake National Recreation Area since 1984. In 1990, wolves with pups were observed near Hozomeen at the north end of Ross Lake (NPS, 2003). Since then, three separate groups of wolves with pups have been observed in the Cascades. Wolves have been observed at McAlester Pass, the Pasayten Wilderness, Twisp River drainage, and Glacier Peak Wilderness, and near Steven's Pass. The WDFW database of priority habitats and species reports two observations of gray wolves in the Baker River basin in 1984 and 1992 (WDFW, 2004). There are no wolf population estimates for the North Cascades area.

Wolves feed primarily on ungulates but will also feed on small mammals. Both forested and open habitats are used when sufficient prey is present year-round, suitable den sites are present, and human exposure is limited. Wolf packs may consist of 2 to 12 animals, and home ranges average about 200 square miles in size. Ungulate populations in the Baker River basin are not large, and this may preclude the area from providing high-quality habitat for wolves. Wolves observed in the Baker River basin are likely transient wolves traveling through the area.

**Grizzly Bear**

The grizzly bear is a federally threatened species. The species is also classified as endangered by the State of Washington. The grizzly bear was listed as federally threatened under the ESA in the 48 contiguous states in 1975 (40 FR 31734). The primary causes of population decline are hunting, human disturbance, and habitat alteration. A recovery plan was prepared in 1982 (FWS, 1982), identifying the need for evaluation of the North Cascades area of Washington to determine habitat condition and status of bear population. The Interagency Grizzly Bear Committee completed this evaluation in 1992, concluding that a small number of grizzly bears inhabit the area and that suitable habitat to support about 200 to 400 bears is present (Almack et al., 1993). The grizzly bear recovery plan was modified in 1993 (FWS, 1993) and was supplemented with a chapter containing a recovery plan for the North Cascades Grizzly Bear Ecosystem (Servheen, 1997). In 1991, a petition was filed to reclassify the grizzly bear in the North Cascades area as endangered; the finding on this petition was that action was warranted but precluded by higher priority actions (56 FR 33892).

Grizzlies are omnivores that use a wide range of habitat types across a large home range. Home ranges of males can be 200 to 500 square miles, while those of females are in the range of 50 to 300 square miles (FWS, 1993). Habitat use varies with season, with lower elevation, snow-free areas used in early spring, mid-elevation habitats during summer, and mid- to high-elevation habitats during late summer and fall (Mace et al., 1999). Presence of roads and humans are negatively correlated with grizzly bear presence.

The North Cascades Recovery Area, established in 1993, extends from the western edge of the Cascade foothills, east to the Okanogan, and south as far as Snoqualmie Pass. Three Bear Management Units (BMUs) border Lake Shannon and Baker Lake: Sisters BMU west of Lake Shannon, Baker BMU west of Baker Lake, and Welker BMU east of both reservoirs. A fourth BMU, Baker-Goodell, encompasses the Upper Baker River basin and the Goodell Creek watershed to the southeast. An assessment of grizzly bear habitat in the North Cascades Recovery Area was performed by the North Cascades Grizzly Bear Ecosystem Technical Team (Forest Service, 2002a). The results of the assessment are summarized briefly below.

Sisters BMU is 100,875 acres in size, with 45.9 percent located on federal lands. Remaining lands are predominantly managed as private timberlands; residential developments are also present. Early and late season core areas are each less than 50 percent of the BMU; preferred habitats in the seasonal core areas are well below the range believed to be necessary to support grizzly bear use. The Sisters BMU is considered to have low likelihood of successful occupancy by grizzly bears.

The Baker BMU is 82,380 acres in size, with 96.7 percent in federal ownership. Early and late core areas fall into the moderate class, with preferred seasonal habitats in the core areas at the low end of the evaluation range. The preferred habitats are within the range believed to be adequate to support occupied habitat, provided that the risk for mortality is low. This BMU experiences a high level of recreational activity, including a climbing route to Mt. Shuksan and other trails. Maintenance or improvement of the quantity and quality of the core area and habitats are objectives for this BMU.

Welker BMU exhibits moderate levels of both early and late season core area, and low (early season) and moderate (late season) levels of preferred habitats in the core areas. The amounts of seasonally preferred habitats are within the range believed necessary to support grizzly bear use, provided that mortality risk is low. Welker BMU is 78 percent federally owned. Recreational pressures are not as high as in the Baker BMU, and the Welker BMU has additional forage resources along over 7 miles of anadromous streams/rivers.

The Baker-Goodell BMU exhibits high amounts of both early and late season core areas and a very high amount of preferred habitat within the late season core. Early season preferred habitat levels were below the midpoint of the evaluation range. A small portion of the 100,821-acre BMU (0.05 percent) is in non-federal ownership, and is located near State Highway 20 and/or other roads.

Puget conducted a study of grizzly bear spring foraging habitat in the project vicinity (EDAW et al., 2003). The relative values of potential and important forage species were evaluated in several habitat types that are currently present in the watershed. Wet meadow habitats provided the greatest amount of potential forage biomass, exceeding the next nearest habitat type by almost twice the biomass. Wet meadow, shrub wetland, and forested wetland provided similar amounts of forage biomass of "important" plant species. Riparian forest and deciduous forest provided low potential and important forage. Reed canarygrass, a dominant grass of herbaceous wetlands near the reservoirs, was listed as a "non-important" forage species; however, this grass provided a substantial amount of biomass in wet meadow habitats in the project area.

The grizzly bear is known to occur in the Upper Baker River watershed (Forest Service, 2002a; WDFW, 2004). Historically, the North Cascades provided high-quality habitat; trapping records indicate that more than 3,700 grizzly bear hides were transported from forts in and near the region between 1827 and 1859 (Servheen, 1997). Grizzly bear numbers declined significantly by the late 1800s. Nine grizzly bears were recorded on the Mt. Baker National Forest, including the Upper Baker River, during 1929 (Forest Service, 2002a). Recent estimates of the North Cascades grizzly bear population range from 12 to 50 individuals (Almack et al., 1993; MacCracken and O'Laughlin, 1998). The most recent grizzly sightings in the project vicinity include an observation of one adult and one young in the Baker River headwaters in 1991, over 10 miles from the project area (WDFW, 2004), and a grizzly bear track recorded in 1989 near Watson Peak, about 4.5 miles east of the Upper Baker dam (WDFW, 2004).

#### 3.3.6.2 Environmental Effects

***Fish Species***

The action area for the analysis of the effects of the Proposed Action on listed fish species and their designated critical habitat extends from the upstream extent of reservoir fluctuations in Baker Lake downstream to the point at which any project related effects on flow in the Baker or Skagit Rivers would be attenuated. As previously discussed, the effects of both the Baker and Skagit hydroelectric projects on river stage in the Skagit River near Concrete can amplify each other (be mutually additive) or somewhat offset each other (be mutually reductive). These interactive effects are largely attenuated by the

time they reach the vicinity of Mt. Vernon on the Skagit River at RM 15.7 (Puget, 2002c). Accordingly, the action area for this analysis includes the mainstem Baker River from the upstream extent of reservoir fluctuations in Baker Lake downstream through both project reservoirs to the Baker/Skagit confluence, and includes the Skagit River from the Baker/Skagit confluence downstream to RM 15.7.

The environmental baseline for this evaluation is "the past and present impacts of all federal, state or private actions and other human activities in the action area, including the anticipated impacts of all proposed federal projects in the action area that have undergone section 7 consultation and the impacts of state and private actions that are contemporaneous with the consultation in progress" (50 CFR 402). The evaluation of the baseline condition is intended to provide a description of current conditions including historical and current actions that have influenced survival of listed species in the action area and contributed to the ESA listing for the species.

Historical and current actions have affected the viability of populations of listed salmonid species. Since the state of available science makes it difficult to determine how a specific action may affect the status of a population, ESA evaluations typically assess the effects of an action on a given habitat component that constitutes the biological requirements of a species. By examining the effects of a given action on the habitat portion of a species' biological requirements, it is possible to assess how the action would affect the population, and ultimately, how the action would affect the species' current and future health. NMFS currently defines the biological requirements in terms of a concept called properly functioning condition (PFC). The PFC is the sustained presence of natural habitat-forming processes in a watershed that are necessary for the long-term survival of the species. In the PFC framework, baseline environmental conditions are described as "properly functioning" (PF), "at risk" (AR), or "not properly functioning" (NPF). The indicators of PFC vary between different landscapes based on the natural processes and the physiographic and geologic features unique to the action area.

The purpose of this analysis of ESA-listed species is to determine if licensing of the Baker River Project under the Proposed Action would have an adverse effect on ESA-listed species and, if appropriate, to provide analyses of project effects on those listed species and any designated critical habitats that are likely to be found in the project area. Determining the effects of a proposed action typically follows a matrix of pathways, through which habitat degradation could occur, and indicators of those effects. A matrix of pathways and indicators was originally developed by the FWS to evaluate the effects of grazing, and it was later modified to evaluate the effects of timber harvest activities. The analysis of the effects of the Baker River Project operations followed a similar evaluation of pathways and indicators that were modified to address action-specific circumstances as recommended by NMFS. In recent NMFS guidance documents, NMFS

has indicated that this determination applies not just to the species and critical habitats levels, but also applies at the individual level.

Table 3-28 is based on a Matrix of Pathways and Indicators (NMFS, 1996) and is designed to describe existing environmental conditions for the action area and summarize the status of each indicator within the PFC framework. NMFS recommends using this process to quantify and standardize the existing environmental baseline conditions for several environmental "pathways" or parameters and to determine the effects of a project on each relevant indictor. Note that the summary status of each indicator is a reflection of all federal, state, or private actions and other human activities in the action area, including, but not limited to, past and current operation of the Baker River Project. For example, road density may be considered "at risk" due to logging, agricultural, and residential development in the Lower Skagit River watershed, even though the Baker River Project may have little or no influence on this indicator. See sections 3.3.1, 3.3.2, 3.3.3, 3.3.4, and 3.3.5 for detailed descriptions of the environmental resources summarized in table 3-28.

Table 3-28. Analysis of environmental baseline, matrix of pathways and indicators.[a]

| Pathway | Indicator | Function | Description | Source |
|---|---|---|---|---|
| **Water Quality** | Temperature | AR | Baker River watershed has excellent water quality, but Lower Skagit River temperatures within at risk range as defined by NMFS. | Land clearing for development, logging |
| | Nutrients | AR | High levels of nitrogen, phosphorus and ammonia recorded in Lower Skagit River | Agriculture, sewage treatment |
| | Turbidity | AR | Landslides in Baker and Skagit tributaries contribute to increased sediment recruitment, Baker reservoirs extend suspension of fine material | Logging, road building, reservoirs |
| **Habitat Access** | Upstream and downstream passage barriers | AR | Estimated downstream fish passage efficiency at Upper Baker facility of 71 percent, Lower Baker downstream passage facility is older and has less pumping capacity | Upper and Lower Baker dams |

| Pathway | Indicator | Function | Description | Source |
|---|---|---|---|---|
| Habitat Elements | Substrate | AR | Landslides in Skagit tributaries contribute to increased sediment recruitment, Baker reservoirs interrupt downstream transport of sand and larger sediment particles | Logging, road building, hydropower reservoirs |
| | Large woody debris | AR | Loss of riparian reserves, hydropower reservoirs interrupt downstream recruitment of wood | Logging, hydropower reservoirs, urban development |
| | Refugia and off-channel habitats | NPF | Off-channel habitat in Skagit River lost to diking, ditching, streambank modification, and channelization | Agricultural/urban development, flood control |
| | Pool frequency and quality | NPF | Reduced complexity of Lower Skagit River channel, LWD jams removed to maintain channel transport capacity | Hydromodification, logging, flood control |
| Channel Conditions /Dynamics | Channel morphology | AR | Lower Skagit River hydromodified, loss of secondary channels particularly evident below town of Sedro-Woolley | Agricultural/urban development, flood control |
| | Streambank condition | NPF | Bank hardening in Lower Skagit River | Agricultural/urban development, flood control |
| Flow/Hydrology | Floodplain connectivity | NPF | Reduced magnitude but extended duration of flood events during fall and winter affect frequency and duration of high flow events, reservoir refill reduces volume of springtime releases | Flood control and power generation at hydropower projects |
| | Peak flows | AR | 48% of Skagit watershed upstream of hydropower projects, but flood control effects are somewhat ameliorated by small storage volume at Baker River Project | Flood control at hydropower projects |

| Pathway | Indicator | Function | Description | Source |
|---|---|---|---|---|
| | Base flows | AR | The 7-day low flow in the Skagit River near Concrete is higher than unregulated conditions due to augmentation from the Skagit River Project; the 7-day low flow at the Baker River at Concrete is 1/3 of 7-day low flow under unregulated conditions. | Power generation at Lower Baker Development |
| | Rapid flow fluctuations | AR | Ramping rates immediately below hydropower projects exceed Washington State guidelines. | Baker and Skagit hydropower projects |
| **Watershed Conditions** | Road density | NPF | Extensive network in Lower Skagit River basin | Logging, urban, agricultural, and residential development |
| | Disturbance history | NPF | Logging throughout lower and mid-level elevations in Skagit River basin, extensive development in Lower Skagit floodplain | Logging, urban, agricultural, and residential development |
| | Riparian reserves | NPF | Riparian reserves good in Baker River basin but poor condition in Middle and Lower Skagit River (as cited by NMFS, 2004a) | Logging, urban, agricultural, and residential development |
| **Biotic Interactions** | Predation | PF | Some predation in reservoirs, such as bull trout on sockeye smolts at passage facilities, but predator population levels do not appear to exceed historical levels | Baker downstream fish passage concentrates juvenile salmonids increasing risk of predation |
| | Competition | PF | Potential competition exists between juvenile coho and bull trout | WDFW and Tribal interests manage coho production |
| | Harvest | PF | Chinook harvest rates reduced from over 80% in 1970s to 50–60% in recent years, bull trout harvest prohibited in Baker River basin (as cited by NMFS, 2004a) | Fisheries Co-managers regulate harvest |

| Pathway | Indicator | Function | Description | Source |
|---|---|---|---|---|

Notes:

**Function Codes**:

PF– Properly functioning.

NPF– Not properly functioning.

AR– At risk.

[a] Unless otherwise noted, the descriptions apply to the biological requirements of the populations of the Puget Sound Chinook salmon ESU and Coastal-Puget Sound bull trout DPS found in the action area.

The following subsections describe the effects of the Proposed Action on ESA-listed fish species and those species regulated under a federal fisheries management plan. Analysis of the effects of future operations of the Baker River Project will be based on indicators specific to the Proposed Action.

Compared to Current Operations, most indicators of the aquatic habitats and biological requirements of Puget Sound Chinook salmon ESU and Coastal-Puget Sound bull trout DPS would be improved under the Proposed Action (table 3-29).

Table 3-29. Analysis of project effects. Summary of effects of the Proposed Action on the Puget Sound Chinook salmon ESU and Coastal-Puget Sound bull trout DPS found in the action area.

| Category | Indicators | Project Area Baseline Function[a] | Effects of Proposed Action[b] | Description of Proposed Action (and relevant Proposed License Article) |
|---|---|---|---|---|
| Water Quality | Temperature | AR | Maintain | Baker River watershed has generally good water quality; existing impairment of Lower Skagit River habitats would be largely unaffected by the Proposed Action. Operation of the FSC(s) would increase resuspension of forebay sediments during initial startup and annual maintenance; however, compliance with terms and conditions of Proposed Article 401 would minimize effects. |
| | Nutrients | AR | Improve | Baker River tributaries are naturally nutrient-poor; the reservoir nutrient enhancement program (Proposed Article 101[f]) would evaluate, and if deemed appropriate, increased nutrients to benefit salmonid production. Existing impairment of Lower Skagit River habitats would be largely unaffected by the Proposed Action. |
| | Turbidity | AR | Maintain | The Erosion Control Plan (Proposed Article 110) and minimum pool level restrictions (Proposed Article 401) would reduce the recruitment and resuspension of sediments that contribute to turbidity; but operation of the FSCs would increase winter-time resuspension of forebay sediments during initial startup and annual maintenance. |
| Habitat Access | Upstream fish passage barriers | AR | Improve | The upstream fish passage implementation plan (Proposed Article 103) would improve the attraction and transport of salmonids and minimize the potential for take associated with holding, handling and transport of listed species. Proposed Article 104 would provide for the evaluation and implementation of connectivity between project reservoirs. |

| Category | Indicators | Project Area Baseline Function[a] | Effects of Proposed Action[b] | Description of Proposed Action (and relevant Proposed License Article) |
|---|---|---|---|---|
| | Downstream fish passage barriers | AR | Improve | The DFPIP (Proposed Article 105) would improve the attraction and downstream transport of juvenile salmonids and minimize the potential for take associated with holding, handling, and transport of listed species. |
| **Habitat Elements** | Substrate | AR | Improve | The Gravel Management Plan (Proposed Article 108) would evaluate, and if deemed appropriate, augment the recruitment of gravel below the Lower Baker Development. The plan would serve to reduce potential project effects on Skagit River habitats supporting spawning of listed species. |
| | Large woody debris | AR | Improve | The LWD Management Plan (Proposed Article 109) would provide for the transport of LWD from project reservoirs where the wood would be available for use in habitat improvement projects. |
| | Refugia and off-channel habitats | NPF | Improve | The aquatic riparian habitat protection, restoration, and enhancement plan (Proposed Article 505) would protect and enhance low-elevation bottomland ecosystems, but the primary sources of impairment of Lower Skagit River habitats are largely unaffected by the Proposed Action. |
| | Reservoir inundation zone | AR | Maintain | Under the FIP (Proposed Article 106), the reservoir management regime would reduce the duration of exposure of the reservoir inundation zone by accelerating spring refill and delaying fall drawdown; winter reservoir operations would continue to affect tributary channel stability within the reservoir area. |
| **Channel Conditions /Dynamics** | Channel morphology | AR | Maintain | The aquatic riparian habitat protection, restoration, and enhancement plan (Proposed Article 505) would protect and enhance low-elevation bottomland ecosystems, but the primary sources of impairment of Lower Skagit River habitats are largely unaffected by the Proposed Action. |

| Category | Indicators | Project Area Baseline Function[a] | Effects of Proposed Action[b] | Description of Proposed Action (and relevant Proposed License Article) |
|---|---|---|---|---|
| Flow/ Hydrology | Floodplain connectivity | NPF | Improve | Under the FIP (Proposed Article 106), reduced hourly flow fluctuations and increased baseflows would improve use of floodplain habitats by listed species, but the primary sources of impairment of Lower Skagit River habitats are largely unaffected by the Proposed Action. |
| | Peak flows | AR | Maintain | Flood flow management is directed by the Corps and is the subject of a separate ESA consultation process. |
| | Base flows | AR | Improve | Under the FIP (Proposed Article 106), 7-day low flows at Baker River at Concrete would substantially increase and exceed unregulated base flow conditions during September and during longer portions of dry years; during wet years or wet months, 7-day low flows will improve compared to baseline conditions, but would remain less than unregulated conditions. Installation of new turbines with flow continuation devices would minimize flow reductions due to load rejections. |
| | Rapid flow fluctuations | AR | Improve | Under the FIP (Proposed Article 106), new facilities would be installed to provide controlled flow releases and satisfy Washington State downramping rate guidelines. |
| Biotic Interactions | Predation | PF | Maintain | Increased forage base for native char (Proposed Article 101) would be offset by reduced opportunity for char feeding on sockeye smolts at the downstream fish passage facilities (Proposed Article 105); increased protection and enhancement of avian predator habitats (Osprey Nest Structures [Proposed Article 506], Loon Floating Nest Platforms [Proposed Article 507], Bald Eagle Management Plans [Proposed Article 513]) would not be expected to result in populations that exceed the natural range of avian densities. |

| Category | Indicators | Project Area Baseline Function[a] | Effects of Proposed Action[b] | Description of Proposed Action (and relevant Proposed License Article) |
|---|---|---|---|---|
| | Competition | PF | Maintain | The FPFP (Proposed Article 101) provides for potential increases in fish production within the Baker River basin; however, the Tribal and state Fish Co-managers would direct the species mix, life stages, and quantities of fish produced in the facilities. |
| | Harvest | PF | Maintain | Harvest rates are directed by the Tribal and state Fish Co-managers; bull trout harvest is currently prohibited in the Baker River basin. |

[a] Function code rating based on analysis of project area consisting of the Baker and Skagit River basins without regard to source of potential impairment. PF: Properly Functioning; NPF: Not Properly Functioning; AR: At Risk.

[b] Effects Codes:

Improve–Appreciably improve functioning of impaired habitat.
Impair–Impair properly functioning habitat.
Maintain–Project effects both improve and impair which are largely offsetting.
Retard–Retard the long-term progress of impaired habitat toward PFC.
NKE–No known significant project effects.

### Puget Sound Chinook Salmon ESU

**Direct Effects—**Direct effects of the Proposed Action on the Puget Sound Chinook salmon ESU and their designated critical habitat occurring within the action area are discussed below.

***Water Quality*:** As previously described in section 3.3.3, water quality in the surface waters of the Baker River basin is generally considered good and meets the needs of designated beneficial uses. Review of Ecology's Water Quality Index components indicates that suspended solids and turbidity are of moderate concern, and all other water quality components are of lowest concern. The primary water quality concerns associated with potential effects on Chinook salmon are temperature, nutrients, and turbidity.

Elevated water temperatures can affect Chinook salmon by altering the timing of adult and juvenile migrations, changing incubation, altering hatching intervals, and possibly contributing to stress-related mortality or reduced growth. Temperature criteria contained in Ecology's proposed revision of the water quality standards criteria calls for the average of seven consecutive measures of daily maximum temperatures (7-DADMax)

to not exceed 16°C for designated core salmon waters. The Baker River downstream of Baker Lake and the mainstem Skagit River are proposed as designated uses for salmon and trout spawning, core rearing, and migrating. Under Current Operations, the 7-DADMax during the summer of 2002 and 2003 was 16.1°C in the Lower Baker River, but the 7-DADMax in the mainstem Skagit River below the Baker River confluence remained below 16°C. Under the terms of Proposed Article 106, Puget would comply with the terms and conditions of the 401 Certification issued by Ecology. Compliance would be measured at the project forebays and tailraces and the Lower Baker fish weir. Compliance is anticipated to improve but not eliminate effects of the Proposed Action on water temperatures compared to Current Operations.

Baseline nutrient conditions in the Lower Skagit River are impaired due to nitrogen, phosphorus, and ammonia contributions associated with agricultural practices and sewage treatment. In contrast, tributaries to the Baker reservoirs are naturally low in nutrients. Under Current Operations, marine-derived nutrients are added to the Upper Baker River basin when sockeye carcasses from the spawning beaches are distributed to Sandy, Park, Swift, and Shannon creeks. This practice would continue under the Proposed Action and would likely increase if adult sockeye returns are increased through proposed articles 101, Fish Propagation; 103, Upstream Fish; and 105, Downstream Fish Passage. In addition, under the Proposed Action, Puget would implement a reservoir nutrient enhancement program. These efforts would increase available nutrients in the Baker River basin while having little or no effect on nutrient conditions in the Lower Skagit River.

Turbidity is elevated in natural streams for short duration during storm and snowmelt events and for longer duration following mass-wasting events. Low levels of turbidity may influence foraging behavior of juvenile salmonids by reducing the distance from which they can locate drifting prey. Higher concentrations of suspended sediments may affect Chinook spawning success if fine sediments settle out over spawning redds, diminishing intragravel flow by clogging substrate interstices. Current Operations of the Baker River Project result in deposition of sands and larger-sized sediments in the project reservoirs. During periods of high sediment influx into the reservoirs, for instance immediately following a mass-wasting event in a reservoir tributary, the reservoirs reduce the downstream transport of sands and larger-sized sediments into the mainstem Skagit River. Thus, the reservoirs serve as settling basins. However, downstream turbidity levels may be elevated when reservoir drawdown resuspends fine sediments that have been deposited in the reservoirs. During repeated cycles of reservoir drawdown, refill, and drawdown, such as for winter flood control, fine sediments deposited within the alluvial fans of the reservoir tributaries may be re-suspended causing low-intensity but extended increases in turbidity.

Under the Proposed Action, Puget would implement a Shoreline Erosion Control Plan (Proposed Article 110) and would have established minimum pool levels in Baker Lake and Lake Shannon that would reduce the recruitment and resuspension of sediments that contribute to turbidity. Implementing the proposed articles would require construction of new project facilities and rebuild of several existing facilities (see section 2.2.1). These efforts may cause temporary increases in turbidity, but discharges would be controlled by measures to be detailed in the water quality monitoring plan, stormwater pollution prevention plan, and in-water work protection plan. These plans would be developed in consultation with Ecology; and compliance with these measures would minimize but not eliminate effects of the Proposed Action on turbidity conditions in the action area (see section 3.3.3.2 for additional description of project effects on turbidity).

***Habitat Access:*** The Baker River system historically supported limited production of Puget Sound Chinook salmon. Although quantitative information is lacking, a fisheries survey conducted in 1921, 4 years before the Lower Baker Development was completed, noted that "a few" Chinook returned to the Baker River. It is not certain whether these Chinook were spring or fall runs, and fisheries harvest rates and land-use activities affected the abundance of Chinook in 1921. Between 1926 and 2002, an average of 220 Chinook salmon returned to the Baker River trap. In 1995, the WDFW recommended that adult Chinook entering the Lower Baker fish trap would have higher reproductive potential if they were returned to the mainstem Skagit River. Since that time, the Fish Co-managers have introduced spring Chinook into the Baker watershed on an experimental basis to determine if spring Chinook are able to take advantage of habitats within and upstream of the project reservoirs. Proposed Article 103, Upstream Fish Passage Implementation Plan, would improve the attraction and transport of salmonids and minimize the potential for take associated with holding, handling, and transport of Puget Sound Chinook salmon. Improvements to the upstream fish passage facility would minimize potential adverse effects of the Proposed Action.

As described in section 3.3.4.1, during the past 11 years, an annual average of 1,303 juvenile Chinook have been collected and transported downstream of the Baker River Project. Proposed Article 105, Downstream Fish Passage Implementation Plan, would improve the attraction and downstream transport of juvenile salmonids. The design and installation of the downstream fish passage facilities would be developed by Puget in consultation with Tribal and state Fish Co-managers, and subject to NMFS and FWS approval. The facility would be subject to performance criteria that would minimize the potential for take associated with holding, handling, and transport of Puget Sound Chinook salmon.

***Habitat Elements:*** Proposed Article 106, Flow Implementation, includes an increase in minimum flow releases from 80 cfs to 1,000 cfs in the Lower Baker River and

several other flow measures designed to protect, mitigate, and enhance aquatic habitat conditions in the mainstem Skagit River. Based on modeling of Middle Skagit River habitats using site-specific data, the Proposed Action is estimated to increase the average width of effective Chinook spawning habitat in the Middle Skagit River from a 5-year weighted average of 28.4 feet under Current Operations, to 30.7 feet under the Proposed Action (see table 3-30). This represents an 8 percent increase in channel width of effective Chinook spawning habitat considering the effects of both scour and dewatering through the egg incubation period. However, existing structural elements of the Lower Baker Development prevent full implementation of the flow measures identified in Proposed Article 106(C) until two new generating units are installed and operating. As described in Proposed Article 106(A), until the new units are constructed, Puget would conduct operations in accordance with the IPP described in NMFS (2004a).

Table 3-30. Transect-weighted, reach-averaged, effective Chinook salmon spawning width in the Middle Skagit River under Current Operations, Interim Protection Plan, and the Proposed Action.

| | | **Transect-Weighted, Reach-Averaged, Effective Spawning Width in Middle Skagit River (feet)** | | |
|---|---|---|---|---|
| | **Energy Year** | **Current Operations** | **Interim Protection Plan** | **Proposed Action** |
| **Chinook salmon (neglecting scour and dewatering)** | 1993 | 39.0 | 40.9 | 40.5 |
| | 1995 | 36.7 | 39.8 | 38.9 |
| | 1996 | 34.9 | 36.4 | 34.6 |
| | 2001 | 38.7 | 40.5 | 40.1 |
| | 2002 | 37.6 | 39.7 | 38.5 |
| | Five-Year, Weighted-Average[a] | **37.3** | **39.7** | **38.8** |
| **Chinook salmon (including scour only)** | 1993 | 38.1 | 39.9 | 39.6 |
| | 1995 | 30.5 | 33.3 | 32.6 |
| | 1996 | 18.8 | 19.4 | 18.8 |
| | 2001 | 38.0 | 39.6 | 39.2 |
| | 2002 | 29.5 | 29.7 | 29.8 |
| | Five-Year, Weighted-Average[a] | **30.9** | **33.3** | **32.8** |
| **Chinook salmon (including dewatering only)** | 1993 | 35.4 | 38.8 | 37.8 |
| | 1995 | 34.7 | 38.8 | 37.0 |
| | 1996 | 32.4 | 34.3 | 33.1 |
| | 2001 | 34.0 | 37.7 | 36.2 |
| | 2002 | 32.4 | 37.8 | 36.8 |

| | Energy Year | Transect-Weighted, Reach-Averaged, Effective Spawning Width in Middle Skagit River (feet) | | |
|---|---|---|---|---|
| | | **Current Operations** | **Interim Protection Plan** | **Proposed Action** |
| | Five-Year, Weighted-Average[a] | **34.3** | **38.1** | **36.7** |
| **Chinook salmon (including both scour and dewatering)** | 1993 | 34.4 | 37.7 | 36.9 |
| | 1995 | 28.5 | 32.2 | 30.7 |
| | 1996 | 16.7 | 17.5 | 17.5 |
| | 2001 | 33.2 | 36.8 | 35.4 |
| | 2002 | 24.5 | 28.0 | 28.3 |
| | Five-Year, Weighted-Average[a] | **28.4** | **31.6** | **30.7** |

[a] Average of 5 energy years (EY) weighted by likelihood of occurrence (EY 1993 Somewhat Dry * 0.231, EY 1995 Average * 0.462, EY 1996 Wet * 0.115, EY 2001 Dry * 0.077, EY 2002 Somewhat Wet * 0.115)

The IPP includes a flow management regime developed in consultation with NMFS and the FWS in an effort to minimize the effects of pre-licensing project operations on Puget Sound Chinook salmon within the structural constraints of existing project facilities. During pre-licensing consultation with NMFS and other interested parties, several alternative flow management strategies were modeled to evaluate project effects on Chinook salmon. Evaluation of the split-spawning season flow management regime indicated that the channel width of effective Chinook spawning habitat in the Middle Skagit River would increase from a 5-year weighted average of 28.4 feet under Current Operations to 31.6 feet under the IPP (table 3-30). The combination of reduced releases from the Lower Baker powerhouse during the first half of the Chinook spawning season and controlled releases during the second half of the Chinook spawning season was designed to complement natural precipitation patterns in the Skagit River basin. Reducing flow releases to the Lower Baker River during the first part of the Chinook spawning season would encourage redd construction deeper in the river channel to reduce risks of dewatering during egg incubation. During the second part of the Chinook spawning season, power generation at the Lower Baker Development would gradually restore available reservoir storage capacity while allowing Chinook redds to be broadly distributed across the Skagit River channel, reducing the risk of egg loss associated with flood events. Further modifications to the IPP in Proposed Article 106(A) are not expected to affect the overall benefit of post-licensing interim operations compared to Current Operations.

Under Current Operations, the Lower Baker Development operates under a voluntary, gradual unit shutdown program consistent with the limitations of the existing, single large generating unit. Under this program, Puget limits the average rate of

reduction of river flow whenever flow in the Skagit River near Concrete (measured at the USGS gage No. 12194000) drops below 18,000 cfs. As described in section 3.3.4.2, the number of downramping events that exceed Washington State standards would be reduced under the Proposed Action. However, until the additional generating units come on-line at the Lower Baker Development, the ability to reduce downramping rates would remain limited by the narrow operating range of the single, large existing unit. During the 6-year, post-licensing interim period, Puget would investigate methods and make best efforts to reduce ramping rates toward the standards identified in Proposed Article 106(C). These efforts would be expected to improve downramping conditions compared to Current Operations but would not provide the level of protection afforded by the flow management regime described in Proposed Article 106(C). During the interim post-licensing period, Chinook fry and juveniles would continue to be exposed to stage reductions that would cause some stranding and associated mortality. Even when the additional units come online, hourly flow fluctuations associated with power generation would cause stranding of Chinook fry and juveniles, although the level of stranding and associated mortality would be expected to be much reduced compared to Current Operations.

The nature and quality of salmonid habitat in rivers is determined, in part, on the transport and instream storage of sediments recruited from upland areas. In free-flowing river channels, coarse, gravel-sized sediment is primarily transported downstream during moderate-to-high flow events and is stored within the channel bed and banks during intervening low-flow periods. Trapping of sediment within upstream areas reduces the sediment yield to downstream reaches and may result in sediment starvation accompanied by bed armoring and incision depending on the channel type. Conversely, if downstream sediment inputs are high and flow diversion or storage substantially reduces the magnitude of flood flows, undesirable amounts of sediment may accumulate within downstream channels.

Prior to construction of the Upper and Lower Baker developments, bedload from the Upper Baker River and its tributaries would deposit in Baker Lake and intervening low gradient reaches, while sediment entering the system downstream of historic Baker Lake would be transported to the Skagit River. Under Current Operations, bedload from the Upper Baker River and all tributaries is stored within the reservoirs. There are no tributaries to the Baker River downstream of Lower Baker dam and only episodic slope failures downstream of Lower Baker dam contribute coarse sediment (gravel-sized and larger) to the mainstem Skagit River. The Gravel Management Plan (Proposed Article 108) would evaluate and, if deemed appropriate, augment the recruitment of gravel below the Lower Baker Development possibly in the Lower Baker River. The plan would serve to reduce potential project effects on Skagit River habitats downstream of the Baker River confluence that support spawning of Puget Sound Chinook salmon.

Woody debris provides habitat space (pools) and structure (cover), provides habitat and food for aquatic invertebrates, helps retain local deposits of gravel, contributes to bank stability, and can be integral to channel migration processes in alluvial reaches. Researchers studying juvenile salmonid use of mainstem Skagit River margin habitats observed that four to five times more juvenile Chinook were observed in channel margin habitat containing debris piles or rootwads compared to margins containing riprap or single logs (Beamer and Henderson, 1998). Most alluvial rivers in the Pacific Northwest formerly contained extensive debris jams, especially in low gradient reaches, which also supported Chinook spawning. Removal of in-channel woody debris has occurred throughout much of the Skagit River basin as a result of timber harvest practices, land-use changes, and flood control. Under Current Operations, the transport of wood from Baker River basin tributaries and reservoir margins has been disrupted, as pieces of wood are either collected and disposed of or are stranded within the reservoirs. LWD tends to collect at the upper end of both reservoirs due to prevailing wind direction, and in past years, recreationists and others have removed and burned a portion of the accumulating rafts of wood. Under the Proposed Action, the LWD Management Plan (Proposed Article 109) would provide for the transport of LWD from project reservoirs to stockpile areas where the wood would be available for use in habitat improvement projects. As described in section 3.3.4.2, Puget's Proposed Action would be limited to transporting and stockpiling LWD, but this action would be expected to improve aquatic habitat conditions in the Skagit and Baker rivers where habitat improvement activities are conducted (table 3-29).

Under unregulated conditions, low-gradient, unconfined river channels migrate back and forth across their floodplains in response to bank erosion and sediment deposition. Channel migration may occur as a result of slow, steady erosion of the outside of a meander bend, or it may occur as a sudden shift into an old channel during flood events. As a result of these processes, natural low gradient, alluvial channels typically develop a network of low-flow channels containing numerous gravel bars, side channels, abandoned oxbow lakes, sloughs and wetlands. Such off-channel and mainstem margin habitats are an important component of juvenile Chinook rearing habitat and provide refuge from high water velocities during flood events (table 3-29).

Under the reservoir management regime modeled to describe Current Operations, reservoir pool levels are managed primarily for power generation and flood storage. Reservoir drawdown begins in late August or early September and spring refill is delayed until late May or June. The reservoir pool levels are held near full pool during July and August to benefit recreational users. As described in section 3.3.4.1, only adult Chinook that enter the Lower Baker trap prior to August 1 are currently hauled and released into Baker Lake as part of an experimental program. Adult Chinook have been observed

spawning in tributaries to Baker Lake and must move upstream through the exposed portions of the tributaries within the reservoir drawdown zone to reach upstream reaches. During the spring, Chinook fry and juveniles must move downstream from the tributary streams and enter the reservoirs through exposed portions of the stream channel.

Under the Proposed Action, the reservoir management regime, described in Proposed Article 106, would reduce the duration of exposure of the reservoir inundation zone by delaying fall drawdown and accelerating spring refill. Winter flood storage, including flood control, would continue to affect tributary channel stability within the reservoir inundation zone.

***Channel Conditions:*** Channel dynamics affect the formation, availability, and quality of off-channel habitat in the Middle and Lower Skagit River. Channel change is currently constrained by land-use changes and flood control operations. Channelization and construction of county flood-control levees, revetments, and roads have disconnected many formerly accessible side channels. Flood control operations at the Baker and Skagit hydroelectric projects have reduced some of the large channel-altering flows that threaten people and property, but these flood events also create new side channels benefiting salmonid habitats in the Middle and Lower Skagit River.

***Flow/Hydrology:*** Typical floodplain habitats include a network of low-flow channels, gravel bars, side channels, abandoned oxbow lakes, sloughs, and wetlands. As previously described, connectivity to floodplain habitats in the Middle and Lower Skagit River has been interrupted by land-use changes and flood control measures. Much of the remaining side channel and backwater slough habitat in the Middle and Lower Skagit River is affected by flow fluctuations associated with power generation at the Lower Baker Development. Under Current Operations, side channels and backwater sloughs may be wetted and dewatered on an hourly basis due to load-following operations (see section 3.3.4.2). Under the Proposed Action, the frequency, hourly rate and daily range of flow fluctuations would be reduced, benefiting juvenile Chinook rearing in off-channel habitats (table 3-29).

Minimum flows in the Lower Baker River under Current Operations total approximately 80-cfs and consist of releases through a 24-inch Darling valve and leakage through the dam abutments. The existing, large generating unit at the Lower Baker Development was installed without a flow continuation device, and the unit can only operate for extended periods within a flow range of approximately 3,200 to 4,100 cfs. During periods of upstream salmon migration, Puget typically generates power for a minimum of 4 hours each day beginning at daylight to provide additional attraction for adult fish staging at the confluence of the Baker and Skagit rivers. Under the FIP (Proposed Article 106), two new turbine generating units would be installed at the Lower

Baker Development to provide controlled flow releases and satisfy Washington State downramping guidelines. The minimum flow releases would increase from 80 cfs to 1,000 cfs. Under the Proposed Action, 7-day low flows measured at the Baker River at Concrete gage would substantially increase and exceed unregulated base flow conditions during September and during longer portions of dry years (see section 3.3.2). During wet years or wet months, 7-day low flows would improve compared to baseline conditions, but would remain less than unregulated conditions. Installation of new turbines with flow continuation devices would minimize the risk of rapid flow reductions and potential stranding of Chinook fry during load rejections (table 3-29).

***Biotic Interactions:*** Analysis of potential effects of predation, competition, and harvest under the environmental baseline suggests that those biotic factors are properly functioning under Current Operations, and the Proposed Action would not be expected to alter that condition (table 3-29). Limited numbers of adult Chinook salmon are currently transported and released into Baker Lake and future management of Chinook salmon in the Skagit and Baker River basins would be directed by the Fish Co-managers and NMFS. The FPFP (Proposed Article 101) would provide for potential increases in fish production within the Baker River basin.

**Indirect Effects**—No indirect effects are known or suspected to occur under existing conditions or under the Proposed Action.

**Cumulative Effects**—Cumulative effects considered for ESA determinations include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area (50 CFR §402.14(g)(3) and (4)). Future federal actions that are unrelated to the proposed action are not considered because they require separate consultation pursuant to section 7 of the ESA. At this time, we are unaware of any specific non-federal (state, tribal, local, or private) actions that are reasonably certain to occur in the action area in the future.

**Conservation Measures**—Under Current Operations, conservation measures include a suite of fish propagation and upstream and downstream fish passage measures (see sections 3.3.4 and 5.1). The Lower Baker plant operates under a voluntary gradual unit shutdown; however, the operational limitations associated with the existing large, single turbine at the Lower Baker powerhouse affect downstream flow releases and downramping rates.

The Proposed Action includes mandatory downramping restrictions, reservoir management guidelines and flow releases (Proposed Article 106) and improved fish passage facilities (proposed articles 103, 104, and 105). Two additional turbines would be constructed at the Lower Baker powerhouse to facilitate meeting instream flow and

downramping restrictions. Sediment and LWD would also be managed in collaboration with the BRCC for potential habitat enhancement use under the Proposed Action (proposed articles 108 and 109).

**Effect Summary**—Compared to Current Operations, the Proposed Action would improve aquatic habitat available for Chinook salmon spawning and incubation during the fall and winter, and would benefit juvenile Chinook salmon utilizing the Baker and lower Skagit Rivers during the spring and summer rearing and outmigration periods. The improvements in aquatic habitat conditions as a consequence of the proposed measures recommended in this draft EIS would contribute to the long-term recovery and sustainability of the Puget Sound Chinook salmon ESU. However, while the overall effects of the conservation measures contained in the Proposed Action would represent significant improvements in the biological requirements and habitat conditions of Puget Sound Chinook salmon, it is likely that some incidental take of individuals and some short and long-term deleterious impacts to critical habitat would occur. Therefore, continued operation of the Baker River Project may affect and is likely to adversely affect individuals belonging to the Puget Sound Chinook salmon ESU and their designated critical habitat (table 3-31).

Table 3-31. Summary of effects determinations for ESA-listed fish species, their designated critical habitat, and EFH that occurs in the Baker River Project action area.

| Species | ESU/DPS | ESA Listing Status/Critical Habitat Designation/EFH | Effects Determination |
|---|---|---|---|
| Chinook salmon | Puget Sound Chinook salmon ESU | Threatened | May Affect, Likely to Adversely Affect |
| | | Critical habitat designated in the mainstem Skagit River | May Affect, Likely to Adversely Affect |
| | | EFH: Baker and Skagit Rivers | May Adversely Affect |
| Bull trout | Coastal-Puget Sound bull trout DPS | Threatened | May Affect, Likely to Adversely Affect |
| | | Designated critical habitat in the mainstem Baker River from the Skagit River confluence to the headwaters, and select tributaries above Baker Lake. Project reservoirs excluded from designation. | May Affect, Likely to Adversely Affect |

| | | | |
|---|---|---|---|
| Coho salmon | Puget Sound/ Straight of Georgia coho salmon ESU[a] | EFH: Baker and Skagit Rivers | May Adversely Affect |
| Pink salmon | Odd-year pink salmon ESU[a] | EFH: Baker and Skagit Rivers | May Adversely Affect |
| [a] ESU is not listed as "threatened" or "endangered" and critical habitat has not been designated for this ESU under the federal ESA; therefore, an ESA effects determination is not warranted. | | | |

**Anticipated Take**—It is anticipated that the Proposed Action would continue to cause some incidental take of Puget Sound Chinook salmon within the action area. Examples of take may include impacts to redds or stranding of fry caused by flow fluctuations. During the first 6 years of a new license, the ability to control releases from the Lower Baker Development would be limited by the operational range of the single existing turbine. Although Puget is committed to investigate methods and make best efforts to reduce ramping rates and reduce the difference between spawning and incubation flows during this interim period (see Proposed Article 106), some dewatering of redds and stranding of Chinook fry would be anticipated. Once the new turbines in the Lower Baker powerhouse are operational and the proposed instream flow regime is fully implemented, the quantity of take would be greatly reduced; however, complete avoidance of take would not be anticipated. Flow fluctuations associated with power generation and flood control would still cause some stranding and take of Chinook salmon fry. Power generation during the fall months may cause some Chinook salmon to spawn higher along the channel margins where they may be at risk of dewatering even though minimum flows from the Lower Baker powerhouse would have increased from 80 cfs to a minimum of 1,000 cfs.

The trapping and transport of adult Chinook salmon entering the Lower Baker trap may cause some fish to be injured, even though new facilities would be constructed, existing facilities would be renovated, and operational procedures would be reviewed and revised in coordination with federal, Tribal and state managers (see Proposed Article 103). Construction impacts and initial start-up of the FSC at both Baker Lake and Lake Shannon would cause some short-term increases in turbidity that would affect downstream Chinook habitats but are not expected to affect survival.

The Proposed Action would cause incidental take of some individuals belonging to the Puget Sound Chinook salmon ESU from the upstream end of Baker Lake downstream to the Skagit River at RM 15.7 through the term of any new license issued. Isolating and quantifying project-specific take is complicated by the influence of non-project related factors occurring upstream of the Baker River confluence but extending downstream into reaches affected by the Baker River Project. These non-project-related influences may include, but are not limited to, daily and hourly flow fluctuations associated with natural runoff from glacial and non-glacial upstream tributaries, the downstream influence of the Skagit River Project, effects of hatchery management, harvest and other natural and anthropomorphic influences. Seasonal or cyclic population fluctuations, or the effects of natural events such as major floods or extended drought would mask direct or indirect take of Chinook salmon related to the Proposed Action. Despite the use of best available science, it is not possible to quantify a specific amount of take of individual Chinook salmon juveniles, adults, or incubating eggs as a result of the Proposed Action.

**Chinook Salmon EFH**

The Proposed Action would continue to result in some short-term and long-term adverse effects on Chinook salmon EFH in the action area. However, the level of protection for Chinook salmon EFH would be improved under the IPP and the Proposed Action, as compared to Current Operations. The suite of conservation measures in proposed articles 101, 103, 105, 106, 108, and 109 for the protection of aquatic resources including the Puget Sound Chinook salmon ESU and their designated critical habitat, would also be adopted as conservation measures for Chinook salmon EFH. The measures that we recommend that would provide a benefit to Chinook salmon EFH include:

- A reservoir nutrient enhancement program (Proposed Article 101).

Proposed Article 101 would provide for evaluating, planning, permitting, and implementing a reservoir nutrient enhancement program, primarily directed at increasing the carrying capacity of project reservoirs for sockeye production. As sockeye salmon production levels increase to 14.5 million sockeye fry per year, reservoir nutrient enhancement would likely be needed and would provide increased aquatic habitat productivity for sockeye as well as juvenile Chinook salmon rearing in project reservoirs.

- Improving upstream and downstream fish passage (proposed articles 103 and 105).

Improvements to project fish passage facilities would improve Chinook salmon EFH within and adjacent to these facilities by providing safe, timely and effective

upstream passage. The new system would include more effective screens on water intakes and fish sorting, holding and transport systems; use water-to-water transfer methods when handling fish; and provide increased or more effective attraction flows to the trap system.

- Improving flows below Lower Baker dam (Proposed Article 106).

Proposed Article 106 would likely substantially improve Chinook salmon EFH, primarily by reducing the frequency and magnitude of flow fluctuations that currently dewaters Chinook salmon rearing, migration, spawning, and incubation habitats downstream of the project (section 3.3.4).

- Augmenting gravel in the Baker and Skagit Rivers (Proposed Article 108).

Proposed Article 108 would require Puget to develop a Gravel Management Plan for evaluating sediment interruption by the project and identifying any gravel augmentation measures to be implemented by Puget. The Gravel Management Plan would focus on improving the geomorphic function of the Lower Baker River alluvial fan and the project-affected downstream reach of the Skagit River. Puget's Gravel Management Plan in Proposed Article 108 would potentially enhance spawning habitat for Chinook salmon in the lower Baker and Skagit rivers.

- Transporting LWD from project reservoirs for future habitat enhancement projects (Proposed Article 109).

Under Proposed Article 109, Puget would develop a LWD Management Plan in consultation with the ARG and TRIG. The LWD Management Plan would provide for the transport of LWD from project reservoirs to a stockpile area within the project boundary.

The LWD Management Plan does not specifically identify locations for installation of LWD captured in project reservoirs. However, the development and implementation of the LWD Management Plan would provide for collection of wood from the Baker River system for potential use both within the project area and for transport around the project downstream to locations in the Skagit River system for habitat enhancement projects. During Current Operations, the downstream movement of LWD in the Baker River system has been impaired by project dams. Although the potential effects on aquatic productivity, due to the lack of LWD that was historically delivered from the Baker River system have not been studied, the role of LWD in Pacific Northwest streams has been linked to channel processes that benefit fish and the aquatic community (Montgomery et al., 2003).

**Bull Trout**

**Direct Effects**—Compared to Current Operations, most indicators of the aquatic habitats and biological requirements of the Coastal-Puget Sound bull trout DPS would be improved under the Proposed Action (table 3-29). Conditions of some habitat indicators would be maintained but no indicators would show overall increased impairment under the Proposed Action. As described in section 3.3.4.1, bull trout currently spawn, rear, and migrate through project reservoirs and some tributaries and exhibit a variety of life history strategies. While the Skagit River downstream of the Baker River confluence is used as a migration corridor for adult and subadult bull trout moving to upstream habitats and juvenile and adult bull trout moving downstream to the Skagit estuary and Puget Sound marine waters, the Middle and Lower Skagit River is not considered to represent spawning habitat for bull trout. The following section describes the direct effects of the Proposed Action on bull trout and their designated critical habitat within the action area.

***Water Quality:*** The effects of the Proposed Action on water quality are similar to those previously described for the Puget Sound Chinook salmon ESU. However, there are some species-specific differences in the response to water quality conditions between bull trout and Chinook salmon. As described in section 3.3.3.1, Ecology adopted a revision to the state water quality standards based on designated uses of specific water bodies. In response to the presence of bull trout in the action area, Baker Lake and all tributaries and the Skagit River have been designated for use by native char. The temperature criteria for designated char waters are more restrictive than designated core salmon/trout waters. The 7-DADMax cannot exceed 12°C for designated char waters, compared to a maximum of 16°C for core salmon/trout waters. Under Current Operations, the 7-DADMax during the summer of 2002 and 2003 exceeded 15°C in the euphotic zone of Baker Lake, the Lower Baker River, and the mainstem Skagit River downstream of the Baker River confluence. Under the terms of Proposed Article 106, Puget would comply with the terms and conditions of the 401 Certification issued by Ecology. Compliance would be measured at the project forebays and tailraces and the Lower Baker fish weir. Compliance would be expected to improve but not eliminate effects of the Proposed Action on water temperatures compared to Current Operations.

The Middle and Lower Skagit River are not considered bull trout spawning areas, so while short-term increases in turbidity may affect feeding and holding behavior, downstream effects of the Proposed Action on turbidity would not significantly affect bull trout reproduction. Compared to Current Operations, the Proposed Action would be expected to cause increases in turbidity levels within the project reservoirs as a result of pump discharges resuspending bottom sediments during annual start-up of the downstream fish passage facilities. Bull trout have primarily been observed spawning in

tributary streams upstream of the project reservoirs; therefore, reproduction would be largely unaffected by increased turbidity levels.

Bull trout rearing and feeding in the reservoirs would be slightly impaired by increased reservoir turbidity from pump discharges associated with operation of the downstream fish passage facilities. The impairment is not expected to be significant and is somewhat offset by reductions in reservoir turbidity associated with implementation of several proposed articles. Bull trout are typically found in western Washington steams and rivers containing glacial meltwater. Although bull trout presence in glacially influenced waters may be due to the associated cold water temperatures, bull trout successfully rear, feed, and hold in turbid, glacially influenced waters. Under Current Operations, repeated cycles of reservoir drawdown and refill re-suspend fine sediments deposited within the alluvial fans of the reservoir tributaries causing low-intensity but extended increases in turbidity compared to Current Operations. Under the Proposed Action, the Erosion Control Plan (Proposed Article 110) and reservoir pool level restrictions (Proposed Article 401) would reduce the recruitment and resuspension of sediments that contribute to turbidity. Implementing the proposed articles would require construction of new project facilities and rebuild of several existing facilities (see section 2.2.1). These efforts may cause temporary increases in turbidity, but discharges would be controlled by measures to be detailed in the water quality monitoring plan, stormwater pollution prevention plan and in-water work protection plan. These plans would be developed in consultation with, and approved by, Ecology, and compliance with these measures would minimize but not eliminate effects of the Proposed Action on turbidity conditions in the action area.

***Habitat Access:*** Adult and larger subadult bull trout caught at the Lower Baker River upstream migrant fish trap are passed upstream to Baker Lake under Current Operations. In the absence of existing barriers, it is not known if all bull trout caught in the trap would have continued upstream in the Baker River on their own volition, or whether these fish were exhibiting natural distributary movements. If not transported upstream and released in Baker Lake, it is likely that at least some of the transported fish would have moved upstream to other Skagit River basin reaches. The transport and release of non-Baker River basin bull trout into Baker Lake may be a beneficial effect for Baker Lake bull trout populations by potentially increasing genetic interactions with other Skagit River basin populations. Since the Skagit River basin supports the largest population of bull trout in the Puget Sound analysis area, the annual average transport of less than 20 bull trout to Baker Lake (see section 3.3.4.1) would not be expected to significantly affect other Skagit River basin populations.

As described in section 3.3.4.2, some injury and mortality associated with handling and transport of bull trout is possible; however, handling mortality is low.

Under Proposed Article 103, Upstream Fish Passage Implementation Plan, new facilities would be constructed, existing facilities would be renovated, and operational procedures would be reviewed and revised in coordination with federal, Tribal, and state managers. Management protocols for the capture, transport and release of bull trout would be developed as part of the fish passage plan.

Under Proposed Article 104, Puget would, in coordination with federal, Tribal, and state managers, provide a fishway between Lake Shannon and Baker Lake. As described in section 3.3.4.2, establishing connectivity between spawning populations of bull trout is a common objective of draft bull trout recovery efforts, except where connectivity may increase hybridization with brook trout. Collection of tissue samples from bull trout within the Baker area subbasins is currently ongoing, and the results of the genetic analyses, along with additional evaluation of connectivity issues provided under the measure, would precede selection of an appropriate fishway design. Establishing connectivity under the Proposed Action would benefit bull trout by reconnecting habitats and subpopulations and providing for increased opportunity for two-way genetic exchange. Potential injury and mortality of bull trout may occur during the handling and transport of fish during operation of the fishway, or during tagging, radio tagging, or other monitoring methods. Adverse effects under this measure are expected to be minimal.

Small numbers of juvenile bull trout are currently captured in the Baker River Project juvenile fish passage facilities and transported downstream (see section 3.3.4.2). It is unknown whether the small numbers of juvenile bull trout collected in the existing facilities are a result of adfluvial fish being inadvertently captured, or a low proportion of the Baker River basin population expressing volitional downstream movement. Some degree of handling mortality likely occurs during the handling and transport of juvenile bull trout, but is thought to be minimal under Current Operations. The DFPIP is the largest capital cost in the suite of proposed measures. Under Proposed Article 105, new facilities would be constructed, existing facilities would be renovated, and operational procedures would be reviewed and revised in coordination with federal, Tribal, and state managers. Under the measure, Puget would provide for the safe and effective attraction, capture and downstream transport of juvenile fish at both Upper Baker and Lower Baker developments. Compliance with performance criteria would ensure that any adverse effects of the measure on bull trout would be minimized. Management protocol for the collection, transport and release for juvenile bull trout would be developed as part of the fish passage plan.

***Habitat Elements:*** Proposed Article 106, Flow Implementation, includes an increase in minimum flow releases from 80 cfs to 1,000 cfs at the Lower Baker Development and several other flow measures designed to protect, mitigate and enhance

aquatic habitat conditions in the mainstem Skagit River. Increased base flows and reduced flow fluctuations would benefit aquatic habitats in the Skagit River (table 3-29), but bull trout use of downstream habitats is primarily limited to holding and migration, which are not heavily flow dependent within the range of Current and Proposed Operations.

Under Current Operations, the Lower Baker Development has operated under a voluntary, gradual unit shutdown program consistent with the limitations of the existing, single large generating unit. As described in section 3.3.4.2, the number of downramping events that exceed WDFW proposed criteria would be reduced under the Proposed Action. However, until the additional generating units come on line at the Lower Baker Development, the ability to reduce downramping rates would remain limited by the narrow operating range of the single, large existing unit. During the 6-year, post-licensing interim period, Puget would investigate methods and make best efforts to reduce ramping rates toward the standards identified in Proposed Article 106. These efforts are expected to improve downramping conditions compared to Current Operations but would not provide the level of protection afforded by the flow management regime described in Proposed Article 106. During the interim post-licensing period, bull trout fry and juveniles moving downstream through the Skagit River would continue to be exposed to stage reductions that would cause some stranding and associated mortality of juveniles. Even when the additional units come on line, hourly flow fluctuations associated with power generation may cause some stranding of bull trout juveniles, although the level of stranding and associated mortality would be expected to be much reduced compared to Current Operations.

The Middle and Lower Skagit River do not support significant bull trout spawning, but channel substrate is one of the most important physical factors influencing the distribution and abundance of bull trout. The distribution of adult bull trout is closely associated with coarse substrates such as large gravels, cobbles and boulders. Sedimentation, by filling in the interstitial spaces within the substrate matrix, can substantially reduce the quality of habitats for use by bull trout. Under the Gravel Management Plan (Proposed Article 108), Puget in cooperation with aquatic resource group would evaluate, and if deemed appropriate, augment the recruitment of gravel below the Lower Baker Development. The plan would serve to reduce potential project effects on Skagit River habitats downstream of the Baker River confluence.

Similar to their association with coarse substrates, bull trout are commonly associated with LWD in pool habitats. Under Current Operations, the transport of wood from Baker River basin tributaries and reservoir margins has been disrupted, as pieces of wood are either collected and disposed of, or are stranded within the reservoirs. LWD tends to collect at the upper end of both reservoirs due to prevailing wind direction, and

in past years, recreationists and others have removed and burned a portion of the accumulating rafts of wood. Under the Proposed Action, the LWD Management Plan (Proposed Article 109) would provide for the transport of LWD from project reservoirs to stockpile areas where the wood would be available for use in habitat improvement projects. As described in section 3.3.4.2, Puget's Proposed Action would be limited to transporting and stockpiling LWD, but this action would be expected to improve aquatic habitat conditions in the Skagit and Baker Rivers where habitat improvement activities are conducted (table 3-29).

Under the reservoir management regime modeled to describe Current Operations, reservoir pool levels are managed primarily for power generation and flood storage. Reservoir drawdown begins in late August or early September and spring refill is delayed until late May or June. The reservoir pool levels are held near full pool during July and August to benefit recreational users. Adult bull trout spawn in select tributaries to Baker Lake and Lake Shannon and must move upstream through the exposed portions of the tributaries within the reservoir drawdown zone to reach upstream reaches. During the spring, bull trout fry and juveniles may move downstream from the tributary streams and enter the reservoirs through exposed portions of the stream channel.

Under the Proposed Action, the reservoir management regime, described in Proposed Article 106, Flow Implementation, would reduce the duration of exposure of the reservoir inundation zone by delaying fall drawdown and accelerating spring refill. Winter flood storage would continue to affect tributary channel stability within the reservoir inundation zone. As described in section 3.3.4.2, both Current Operations and the Proposed Action may result in dewatering of potential bull trout spawning habitat at tributary deltas in Baker Lake and possibly Lake Shannon. Estimates of the drawdown zone are given in section 3.3.4.2. The vast majority of bull trout spawning is believed to occur in tributary reaches upstream of the drawdown zone; therefore, effects of the Proposed Action on bull trout reproduction would not be expected to present a significant risk to the population.

***Channel Conditions:*** The effects of the Proposed Action on channel conditions in the Skagit and Baker River basins are expected to be similar for bull trout habitats as those previously described for Chinook salmon habitats.

***Flow/Hydrology:*** Under Current Operations, side channels and backwater sloughs in the Skagit River below the Baker River confluence may be wetted and dewatered on an hourly basis due to load-following operations (see section 3.3.4.2). Under the Proposed Action, the frequency, hourly rate, and daily range of flow fluctuations would be reduced, benefiting off-channel habitat conditions. Under the Proposed Article 106, two new turbine generating units would be installed at the Lower Baker Development to

provide controlled flow releases and satisfy Washington State downramping guidelines. Minimum flow releases in the Lower Baker River would increase from 80 cfs to 1,000 cfs. Increased base flows under the Proposed Action would slightly benefit bull trout holding and migration in the Skagit River (table 3-29). Installation of new turbines with flow continuation devices would minimize the risk of rapid flow reductions and potential stranding of bull trout juveniles migrating downstream through the Skagit River. Evaluation of flow and hydrology indicators suggest that the Proposed Action would slightly improve Skagit River habitats compared to Current Operations, but bull trout use of downstream habitats is primarily limited to holding and migration, which are not heavily flow dependent within the range of Current Operations and Proposed Operations.

***Biotic Interactions:*** Analysis of potential effects of predation, competition, and harvest under the environmental baseline suggests that those biotic factors are properly functioning under Current Operations, and the Proposed Action would not be expected to alter those conditions (table 3-29). The FPFP (Proposed Article 101) provides for potential increases in fish production within the Baker River basin. As described in section 3.3.4.2, the greater the number of hatchery fished introduced to a system, the greater likelihood that hatchery and wild fish would adversely interact. Increased production of sockeye fry may provide an increased prey base for bull trout, but increasing the production of coho in the Baker River basin may increase potential competition between coho and bull trout. The Tribal and state Fish Co-managers, FWS and NMFS would direct the species mix, life stages and quantities of fish produced in the facilities. Harvest of bull trout is currently prohibited in the Baker River basin and the FWS and Fish Co-managers would direct future management of bull trout in the Skagit and Baker River basins.

**Indirect Effects**—No indirect effects are known or suspected to occur under existing conditions or under the Proposed Action.

**Cumulative Effects**—Cumulative effects considered for ESA effects determinations include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area (50 CFR §402.14(g)(3) and (4)). Future federal actions that are unrelated to the proposed action are not considered because they require separate consultation pursuant to section 7 of the ESA. At this time we are unaware of any specific non-federal state, tribal, local, or private actions that are reasonably certain to occur in the action area in the future.

**Conservation Measures—**Under the Proposed Action, conservation measures include a suite of fish propagation, upstream and downstream fish passage, flow management and habitat improvement measures. Proposed articles for bull trout are the same as those listed for other species; however, connectivity between Lake Shannon and

Baker Lake (Proposed Article 104) would likely be more important to bull trout conservation than for other species.

**Effect Summary**—The aggregate effects of the Proposed Action and cumulative effects in the action area, when considered in light of the environmental baseline, would not likely jeopardize the continued existence of the Coastal-Puget Sound bull trout DPS. As previously discussed, native char in the Baker River basin and Skagit River downstream of the Baker River confluence are considered to be part of the Lower Skagit River subpopulation. The Lower Skagit River subpopulation is the only one considered "strong" by the FWS in the Puget Sound analysis area and improvements to bull trout habitat associated with the Proposed Action would be expected to strengthen the viability of the Lower Skagit River subpopulation.

The FWS designated the Baker River mainstem and select tributaries as critical habitat for the Coastal-Puget Sound bull trout DPS on September 2, 2005 (50 CFR Part 17). The project reservoirs were excluded from this designation. The Proposed Action would result in construction-related impacts (see section 3.3.4) and other short-term and long-term adverse effects on bull trout designated critical habitat in the action area, but as compared to Current Operations, the overall effect would be beneficial. Under the Proposed Action, enhancements to fish passage facilities, increased fish propagation measures, flow management changes designed to benefit aquatic resources, and habitat improvement measures would improve or maintain habitat conditions for bull trout and reduce the risk of injury or mortality associated with project operations. Continued operation of the Baker River Project under the Proposed Action may affect and is likely to adversely affect the Coastal-Puget Sound bull trout DPS and their designated critical habitat (table 3-31). Although the overall effect of the conservation measures contained in the Proposed Action represent significant improvements in the biological requirements and habitats of Coastal-Puget Sound bull trout DPS, it is likely that some incidental take of individuals would occur.

**Anticipated Take**—It is anticipated that the Proposed Action would cause some incidental take of Coastal-Puget Sound bull trout within the action area. Biologists assigned to the fish passage facilities have noted very few injuries or mortalities associated with the collection and transport of bull trout. However, during June 2004, two bull trout mortalities were observed in the holding pond of the upstream fish passage facility. The exact source of mortality is unknown, but a river otter (*Enhydra lutra*) was observed in the facility and may have contributed to or caused the mortalities. The relocation of bull trout entering the fish passage facilities may also be considered a form of harassment that is prohibited without a specific permit or exemption. Under proposed articles 103, 104 and 105, new facilities would be constructed, existing facilities would

be renovated, and operational procedures would be reviewed and revised in coordination with federal, Tribal and state managers and subject to approval by NMFS and FWS.

In addition to bull trout that are collected and transported at the fish passage facilities, an unknown number of bull trout pass through the spillways or turbines and are exposed to potential injury and mortality. Construction impacts and initial start-up of the FSC at both Baker Lake and Lake Shannon would cause some short-term increases in turbidity that would affect bull trout habitats. Management of reservoir levels may impact redds within the drawdown zone or impede the passage of bull trout through portions of tributary channels exposed by dropping reservoir levels.

Flow fluctuations downstream of the Lower Baker powerhouse associated with project power generation may affect native char in the lower mainstem Skagit River. Adult and sub-adult char in the Skagit River downstream of the Baker River confluence appear to be primarily using the reach as a migration corridor to move between streams in the Upper Skagit and Sauk River basins and the Skagit estuary and Puget Sound. Native char have been observed in the Middle Skagit River, but available data suggest spawning and rearing primarily occur in upstream tributaries.

The Proposed Action would cause incidental take of some Coastal-Puget Sound bull trout from the upstream end of Baker Lake downstream and into the Skagit River through the term of any new license issued. Levels of collection and transport of native char can be accurately quantified (see section 3.3.4), but despite the use of best available science, it is not possible to quantify a specific amount of take of individual fish or incubating eggs as a result of the Proposed Action.

**Coho Salmon EFH**

Adult coho salmon primarily utilize reservoir tributary streams, and side channels and tributaries to the mainstem Skagit River for spawning; juvenile coho salmon utilize the mainstem Baker and Skagit River systems within and upstream of the action area for rearing and migration life history strategies. Reservoir management described in the Proposed Action would continue to adversely affect coho salmon EFH within the reservoir drawdown zone, and flow fluctuations associated with power generation would continue to negatively affect coho salmon EFH in the lower Baker and Skagit Rivers. However, implementation of the conservation measures recommended in the Proposed Action would improve coho salmon EFH as compared to Current Operations. The measures that we recommend that would provide a benefit to coho salmon EFH include:

- A reservoir nutrient enhancement program (Proposed Article 101).

Proposed Article 101 would provide for evaluating, planning, permitting, and implementing a reservoir nutrient enhancement program, primarily directed at increasing the carrying capacity of project reservoirs for sockeye production. As sockeye salmon production levels increase to 14.5 million sockeye fry per year, reservoir nutrient enhancement would likely be needed and would provide increased aquatic habitat productivity for sockeye as well as coho salmon rearing in project reservoirs.

- Improving upstream and downstream fish passage (proposed articles 103 and 105).

Improvements to project fish passage facilities would improve coho salmon EFH within and adjacent to these facilities by providing safe, timely and effective upstream passage. The new system would include more effective screens on water intakes and fish sorting, holding and transport systems; use water-to-water transfer methods when handling fish; and provide increased or more effective attraction flows to the trap system.

- Improving flows below Lower Baker dam (Proposed Article 106).

Proposed Article 106 would likely improve coho salmon EFH, primarily by reducing the frequency and magnitude of flow fluctuations that currently lead to fish stranding and redd dewatering in the Skagit River downstream of the Baker River confluence (section 3.3.4). Increases in anadromous fish production as a result of flow improvements in Proposed Article 106 would increase marine-derived nutrient input into the Baker and Skagit river systems, and therefore, enhance coho salmon EFH.

- Augmenting gravel in the Baker and Skagit Rivers (Proposed Article 108).

Proposed Article 108 would require Puget to develop a Gravel Management Plan for evaluating sediment interruption by the project and identifying any gravel augmentation measures to be implemented by Puget. The Gravel Management Plan would focus on improving the geomorphic function of the Lower Baker River alluvial fan and the project-affected downstream reach of the Skagit River. Puget's Gravel Management Plan in proposed Article 108 would enhance spawning habitat for Chinook salmon and possibly other fish species in the Lower Baker River. The plan would also address the relationship between substrate sizes and biological needs of aquatic organisms, including coho salmon. Gravel augmentation that is implemented as a consequence of this analysis would have the potential to benefit coho salmon EFH.

- Transporting LWD from project reservoirs for future habitat enhancement projects (Proposed Article 109).

Under Proposed Article 109, Puget would develop a LWD Management Plan in consultation with the ARG and TRIG. The LWD Management Plan would provide for the transport of LWD from project reservoirs to a stockpile area within the project boundary.

The LWD Management Plan does not specifically identify locations for installation of LWD captured in project reservoirs. However, the development and implementation of the LWD Management Plan would provide for collection of wood from the Baker River system for potential use both within the project area and for transport around the project downstream to locations in the Skagit River system for habitat enhancement projects. During Current Operations, the downstream movement of LWD in the Baker River system has been impaired by project dams. Although the potential effects on aquatic productivity, due to the lack of LWD that was historically delivered from the Baker River system have not been studied, the role of LWD in Pacific Northwest streams has been linked to channel processes that benefit fish and the aquatic community (Montgomery et al., 2003).

Coho salmon evolved in freshwater ecosystems that were historically characterized by a high degree of structural complexity including LWD complexes in streams, flood plains, braided channels, beaver ponds and, in some cases, lakes (ODFW, 1995). LWD creates habitat complexity by forming back eddies and side channels (off-channel habitats), pools, and by increasing channel meanders and hydraulic complexity (Spence et al., 1996). Off-channel habitat availability is an important factor in juvenile coho salmon over-winter survival. The complex habitats created by LWD provide refuge for over-wintering coho salmon juveniles during seasonal high flow events. Any benefits to aquatic habitat as a consequence of LWD placement within the range of anadromous fish use in the Skagit River watershed would lead to an enhancement of coho salmon EFH.

**Pink Salmon EFH**

The Proposed Action would continue to adversely affect pink salmon EFH in the action area; however, analysis of the effects of the IPP and the Proposed Action operations on pink salmon spawning, incubation, and migration habitats suggest that the level of protection would be improved under both scenarios as compared to Current Operations (table 3-32). The majority of pink salmon spawn in the Skagit and Sauk rivers above the Baker River confluence; however, pink salmon spawning habitat exists in the upper Baker River and extends downstream through the project to the Lower Skagit River. During the interim operating period prior to construction and operation of the additional turbines at the Lower Baker Development, Puget would conduct operations in accordance with the IPP. Project downstream flow releases would be reduced during the majority of the pink salmon spawning period and thereby minimize the risk of redd

dewatering during the subsequent pink salmon incubation period. Specific conservation measures that would improve pink salmon EFH include:

- Improving upstream and downstream fish passage (proposed articles 103 and 105)

Improvements to project fish passage facilities would improve pink salmon EFH within and adjacent to these facilities by providing safer and more efficient fish passage. The new fish passage system would include more effective screens on water intakes and fish sorting, holding and transport systems; use water-to-water transfer methods when handling fish; and provide increased or more effective attraction flows to the trap system. Decreased mesh size on downstream collection devices from 1/4-inch to 1/8-inch in guide nets would be especially beneficial to pink salmon juveniles because of their small body size during emigration to saltwater.

- Improving flows below Lower Baker dam (Proposed Article 106)

Proposed Article 106 would likely substantially improve pink salmon EFH, primarily by reducing the frequency and magnitude of flow fluctuations that currently dewater pink salmon spawning, incubation, and migration habitats downstream of the project (section 3.3.4).

- Augmenting gravel in the Baker and Skagit Rivers (Proposed Article 108)

Proposed Article 108 would require Puget to develop a Gravel Management Plan for evaluating sediment interruption by the project and identifying any gravel augmentation measures to be implemented by Puget. The Gravel Management Plan would focus on improving the geomorphic function of the Lower Baker River alluvial fan and the project-affected downstream reach of the Skagit River. Puget's Gravel Management Plan in Proposed Article 108 would enhance spawning habitat for Chinook salmon and possibly other fish species, including pink salmon, in the Lower Baker River. The plan would also address the relationship between substrate sizes and biological needs of aquatic organisms, including pink salmon. Gravel augmentation that is implemented as a consequence of this analysis would have the potential to benefit pink salmon EFH.

- Transporting LWD from project reservoirs for future habitat enhancement projects (Proposed Article 109)

Under Proposed Article 109, Puget would develop a LWD Management Plan in consultation with the ARG and TRIG. The LWD Management Plan would provide for

the transport of LWD from project reservoirs to a stockpile area within the project boundary.

The LWD Management Plan does not specifically identify locations for installation of LWD captured in project reservoirs. However, the development and implementation of the LWD Management Plan would provide for collection of wood from the Baker River system for potential use both within the project area and for transport around the project, downstream to locations in the Skagit River system for habitat enhancement projects. During Current Operations, the downstream movement of LWD in the Baker River system has been impaired by project dams. Although the potential effects on aquatic productivity, due to the lack of LWD that was historically delivered from the Baker River system have not been studied, the role of LWD in Pacific Northwest streams has been linked to channel processes that benefit fish and the aquatic community (Montgomery et al., 2003).

Table 3-32. Transect-weighted, reach-averaged, effective Pink and Chum Salmon and Steelhead spawning width in the Middle Skagit River under Current Operations, Post-Licensing Interim Protection Plan, and the Proposed Action.

| | | **Transect-Weighted, Reach-Averaged, Effective Spawning Width in Middle Skagit River (feet)** | | |
|---|---|---|---|---|
| | **Energy Year** | **Current Operations** | **Post-Licensing Interim Protection Plan** | **Proposed Action** |
| **Pink salmon (including both scour and dewatering)** | 1993 | 3.3 | 3.7 | 3.7 |
| | 1995 | 3.6 | 4.5 | 3.9 |
| | 1996 | 1.3 | 1.3 | 1.3 |
| | 2001 | 3.0 | 3.6 | 2.8 |
| | 2002 | 2.6 | 3.6 | 4.1 |
| | Five-Year, Weighted-Average[a] | **3.1** | **3.8** | **3.5** |
| **Chum salmon (including both scour and dewatering)** | 1993 | 4.4 | 5.6 | 6.1 |
| | 1995 | 8.3 | 9.3 | 8.0 |
| | 1996 | 2.2 | 2.1 | 2.5 |
| | 2001 | 7.4 | 7.7 | 9.6 |
| | 2002 | 3.9 | 6.8 | 7.3 |
| | Five-Year, Weighted-Average[a] | **6.1** | **7.2** | **7.0** |

| | | Transect-Weighted, Reach-Averaged, Effective Spawning Width in Middle Skagit River (feet) | | |
|---|---|---|---|---|
| | **Energy Year** | **Current Operations** | **Post-Licensing Interim Protection Plan** | **Proposed Action** |
| **Steelhead (including both scour and dewatering)** | 1993 | 9.4 | 9.5 | 10.5 |
| | 1995 | 11.4 | 11.7 | 11.9 |
| | 1996 | 10.7 | 9.6 | 11.0 |
| | 2001 | 11.7 | 11.5 | 11.6 |
| | 2002 | 10.0 | 10.1 | 10.3 |
| | Five-Year, Weighted-Average[a] | **10.7** | **10.8** | **11.3** |

[a] Average of 5 energy years (EY) weighted by likelihood of occurrence (EY 1993 Somewhat Dry * 0.231, EY 1995 Average * 0.462, EY 1996 Wet * 0.115, EY 2001 Dry * 0.077, EY 2002 Somewhat Wet * 0.115)

### *Plant Species*

#### Golden Paintbrush

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct and Indirect Effects**—Golden paintbrush and its habitat are not present in the Baker River basin. The species range is restricted to low elevations in the Puget Trough ecoregion. No direct or indirect effects on the species or its habitat would occur under the Proposed Action.

**Cumulative Effects**—The project has not contributed, nor would it contribute in the future, to cumulative effects on golden paintbrush or its habitat. Other actions expected to occur within the basin would not affect golden paintbrush, due to the lack of habitat.

**Conservation Measures**—No conservation measures are proposed for the protection of golden paintbrush.

**Determination of Effect**—Implementation of the Proposed Action would have no effect on golden paintbrush individuals or populations or their habitat.

*Wildlife Species*

**Oregon Spotted Frog (Candidate)**

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct and Indirect Effects**—Oregon spotted frogs are not present at the Baker River Project. Historically, one population was reported two miles northwest of the Town of Concrete (McAllister and Leonard, 1997). This population may have been located at the extreme south end of the Baker River Project area. However, surveys for this species in the Baker River watershed during the summer of 2001 (Hamer Environmental, 2002a) and general amphibian surveys in the Baker River Project reservoir area in 2002 (Hamer Environmental and R2, 2003d) did not detect any Oregon spotted frogs.

**Cumulative Effects**—The Proposed Action includes a measure to improve the protection and quality of wetlands in the project area and could offset some of the cumulative loss of amphibian breeding habitat in the basin. Recreational use of the basin would likely increase over time; however, during the term of the new license, land use regulations are expected to remain protective of wetland habitats.

**Conservation Measures**—The Proposed Action includes measures that would reduce water level fluctuations in Baker Lake and Lake Shannon and would acquire wetlands, in part, to provide breeding habitat for native amphibians.

**Determination of Effect**— The Oregon spotted frog is a candidate species; therefore, no determination of effect is needed under the ESA. Nevertheless, implementation of the Proposed Action would have no effect on the Oregon spotted frog because this species is not present at the project.

**Bald Eagle**

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct Effects—**

***Reservoir Level Management:*** No direct effects would be expected to occur to wintering or breeding bald eagles as a result of the reservoir level management regime to be implemented under the Proposed Action. The reservoirs would be managed under

current direction for the next 6 years, until the Lower Baker power plant modifications are completed. At that time, the new management regime would be implemented; typical reservoir patterns of winter drawdown and summer high water levels would not change under the new regime.

***Project Releases:*** No adverse effects are expected to occur to wintering or breeding bald eagles as a result of the project releases to be implemented under the Proposed Action. Project releases from the Upper and Lower Baker developments would remain at current levels until the Lower Baker power plant modifications are completed. At that time, increased minimum flow and seasonal ramping rate requirements would be implemented. Over time, the FIP is expected to result in reduced levels of fish stranding and redd dewatering, contributing to greater fish productivity in the Lower Skagit River. Increases in available salmonid food resources could benefit bald eagles, primarily during the winter season.

***Lower Baker Power Plant Modifications:*** The Proposed Action includes a proposal to modify the Lower Baker powerhouse (refer to section 2.2.1 for a description of the modifications and to section 3.3.5.2 for a description of effects on terrestrial resources). Construction of the access platform and reconstruction of the powerhouse structure would require clearing of approximately one acre of young deciduous riparian forest dominated by alder. The construction activity would not be located near bald eagle nest sites and would not remove large overstory perch trees. Bald eagles have not been observed perching in trees at the powerhouse site, but they are known to use large perch trees on the right bank of the river opposite the powerhouse and to forage in the powerhouse reach of the river.

Construction activity at the powerhouse site is not expected to affect nesting bald eagles since none are present near the powerhouse site. The closest known nesting territory is approximately 2 miles distant, along the Skagit River.

The noise and human activity associated with construction could affect wintering bald eagles by temporarily displacing them from foraging and perching habitat in the Lower Baker powerhouse vicinity. Preliminary site investigations and excavation of old facilities would occur over an approximately 3-month period prior to construction; this activity is tentatively scheduled to occur from late March through late May. Construction of the powerhouse facility is expected to occur primarily during a 24-month period, with winter outdoor work shutdowns occurring between late November and early March. The proposed construction schedule would result in the majority of noise-generating activity occurring outside of the documented peak bald eagle wintering period at Lake Shannon, December through February, and outside of the generalized critical winter roost period identified for Washington State of November 15 through March 15 (Watson and

Roderick, 2002). Any displacement of bald eagles resulting from the powerhouse reconstruction would be temporary and would affect a localized portion of the available foraging and perching habitat in the basin. Therefore, this activity may affect, but is unlikely to adversely affect, bald eagles.

***Aquatic Measures:*** The Proposed Action includes aquatic resource measures that would involve construction of new facilities (proposed articles 101, 103, 104, and 105). The effects of construction of these facilities on terrestrial resources are described in section 3.3.5.2.

*Upper Baker Development FSC Construction and Launch Site:* Construction activities at the FSC launch site are described in section 2.2. The effects of construction of this temporary facility on terrestrial resources are described in section 3.3.5.2. Construction of the FSC construction and launch site itself is expected to take just over 4 months between early November and early March. The site would be used for FSC construction for one year, beginning the following August and concluding with breaching and floating of the FSC in August of the next year. Restoration grading and revegetation activities would occur during the fall and winter following completion of construction and would extend from November to March. Monitoring of the restoration activities would continue for 5 years to ensure successful revegetation of the site.

Construction and use of the FSC construction and launch site is not expected to affect nesting bald eagles, as no known nest sites are located in the vicinity. The nearest known bald eagle nest site is at Maple Grove, approximately 2 miles north of the FSC construction and launch site, on the east side of Baker Lake.

Wintering bald eagles could be temporarily disturbed and/or displaced from foraging or perching activity as a result of noise and human activity associated with the FSC construction and launch site. Temporary increases in noise levels would occur as a result of heavy equipment and pile-driving activities during berm construction (November through early March), and from construction vehicles and activities during the construction of the FSC (one calendar year). Operation of heavy equipment and pile driving can be disturbing or even injurious to wildlife, depending upon whether the disturbance occurs during critical life history periods and the proximity to habitat used by the species.

The FWS developed combined injury threshold distances for bald eagles, marbled murrelets and northern spotted owls (table 3-33), with potential injury described as adults flushing from a nest or aborting or postponing a feeding attempt (FWS, 2003).

Bald eagles have not been observed in trees found on the FSC site, but are commonly observed perching on trees across the lake near Anderson Point, about 0.25 mile distant. Construction noise and activity may temporarily displace foraging or perching bald eagles in the vicinity of the FSC site during two successive winters, including portions of the critical roost period (Watson and Roderick, 2002) of November 15 through March 15. During the third winter of the construction, activity would include restoration grading as well as installation of plant materials.

Approximately 7 acres of habitat would be affected by construction of the FSC construction and launch site. The site would be located primarily within non-vegetated or sparsely vegetated areas of the reservoir drawdown zone. Shoreline habitats dominated by the invasive weed reed canarygrass and upslope, previously disturbed habitats characterized by deciduous tree and shrub species would also be affected. Portions of the site not needed for permanent facilities would be revegetated upon completion of construction. Individual trees that could be used as bald eagle perches may be removed; however, no known perch or roost trees would be cleared. No effect to bald eagle nesting habitat would be expected to occur as a result of this action.

In conjunction with downstream fish passage improvements, a series of stress relief ponds would be constructed along the Lower Baker River near its confluence with the Skagit River. The ponds would be installed within the Lower Baker compound area, which is highly disturbed and mostly non-vegetated.

Table 3-33. Effects determinations by type of disturbance (construction noise) and operating period for marbled murrelets, northern spotted owls and bald eagles. (Source: FWS, 2003)

| | **Activity** | | |
|---|---|---|---|
| **Species Effect** | **Chainsaws Falling Trees and Cutting Downed Wood** | **Heavy Equipment/ Motorized Tools** | **Impact Pile Drivers** |
| **Marbled Murrelet** | | | |
| No effect | | | |
| 9/16–3/30 | Any | Any | Any |
| 8/6–9/15 | > 45 yards[a] | > 35 yards[a] | > 60 yards[a] |
| NLAA[b] | | | |
| 4/1–8/5 | > 45 yards[a] | > 35 yards[a] | > 60 yards[a] |
| 8/6–9/15 | < 45 yards | < 35 yards | < 60 yards |
| LAA[c] | | | |
| 4/1–8/5 | < 45 yards | < 35 yards | < 60 yards |

| | | | |
|---|---|---|---|
| **Northern Spotted Owl** | | | |
| No Effect | | | |
| 10/1–2/28 | Any | Any | Any |
| 7/16–9/30 | > 65 yards [a] | > 35 yards[a] | > 60 yards[a] |
| NLAA[b] | | | |
| 3/1–7/15 | > 65 yards[a] | > 35 yards[a] | > 60 yards[a] |
| 7/16–9/30 | < 65 yards | < 35 yards | < 60 yards |
| LAA[c] | | | |
| 3/1–7/15 | < 65 yards | < 35 yards | < 60 yards |
| **Bald Eagle** | | | |
| No Effect | | | |
| 8/16–10/30 | | >0.25-mile not in line-of-sight or >0.50-mile line-of-site | > 1 mile/ |
| NLAA[b] | | | |
| 1/1–8/15 or 10/31–3/15 | | >0.25-mile not in line-of-sight or >0.50-mile line-of-site[a] | >0.25 mile[a] |
| LAA[c] | | | |
| 1/1–8/15 or 10/31–3/15 | | <0.25-mile not in line-of-sight or <0.50-mile line-of-site | < 0.25 mile |

[a] FSC launch site distance
[b] Not Likely to Adversely Affect
[c] Likely to Adversely Affect

Construction of the stress relief ponds would not be expected to affect nesting bald eagles. No bald eagle nest sites have been documented in the vicinity of the site; the closest nest site is approximately 1.5 miles away along the Skagit River.

Construction of the ponds would generate noise from heavy equipment and would involve human activity at the site for a period of relatively short duration. Short-term effects could include displacement of bald eagles that may perch or forage in the vicinity of the construction site. No overstory trees would be removed for construction of the stress relief ponds. Therefore, no removal of bald eagle perching or roosting habitat would occur.

*Lower Baker Development FSC Construction and Launch Site:* Construction activities at this site would be of similar type and duration as described above for the

Upper Baker FSC construction and launch site. Construction of the Lower Baker FSC would occur several years after completion of the installation of the Upper Baker FSC; no overlap in construction periods is expected.

Construction of the Lower Baker FSC construction and launch site would not be expected to affect nesting bald eagles as no known nest sites are located in the vicinity. The nearest known bald eagle nest site is along the Skagit River, more than 2 miles from the proposed FSC construction and launch site and more than 2 miles from the FSC installation site at the Lower Baker dam. The Thunder Creek nest site is almost 3 miles north of the FSC construction and launch site.

Construction noise and activity at the Lower Baker FSC construction and launch site may temporarily displace foraging or perching bald eagles in the vicinity of the FSC construction and launch site during two successive winters, including portions of the critical roost period (Watson and Roderick, 2002) of November 15 through March 15. During the third winter of the construction, activity would be limited to restoration work, which would rely primarily on manual installation of plant materials, with very limited use of heavy equipment.

Approximately 7 acres of habitat would be affected by construction of the Lower Baker FSC construction and launch site. The site would be located primarily within non-vegetated or sparsely vegetated areas of the reservoir drawdown zone. Shoreline habitats dominated by the invasive weed reed canarygrass and upslope, previously disturbed habitats characterized by deciduous tree and shrub species would also be affected. Portions of the site not needed for permanent facilities would be revegetated upon completion of construction. Individual trees that could be used as bald eagle perches may be removed; however, no known perch or roost trees would be cleared. No adverse effect on bald eagle nesting habitat would be expected to occur as a result of this action.

*Fish Propagation and Enhancement Programs and Facilities:* Under Proposed Article 101, Sockeye Spawning Beach 4, located near the confluence of Sulphur Creek and the Baker River, would be improved. All improvements would likely occur within the existing special use permit area, which is dominated by constructed facilities and adjacent, cleared and disturbed habitats. A new hatchery facility would be constructed within the footprint of the existing facility.

Implementation of the Spawning Beach 4 improvements, including the new hatchery, is not expected to affect nesting bald eagles. No bald eagle nest sites have been documented in the vicinity of Sulphur Creek; the closest nest site is approximately 3 miles away at Maple Grove.

Construction of the facilities would generate noise from heavy equipment and would involve human activity at the site for a period of relatively short duration. Short-term effects could include displacement of bald eagles that may perch or forage in the vicinity of the construction site. No overstory trees would be removed for construction of the upgraded spawning beach and hatchery facilities. Therefore, no removal of bald eagle perching or roosting habitat would occur.

Spawning beaches 1, 2, and 3 at the upper end of Baker Lake would be decommissioned, including restoration of vegetation along Channel Creek. Noise and human disturbance associated with this activity could potentially disturb nesting bald eagles at the Baker River nest site and/or wintering bald eagles that may forage or perch in the vicinity. Decommissioning of the site would be scheduled during the low water season, due to the need for instream work, and therefore, could potentially be scheduled outside of the bald eagle breeding season. No removal of overstory trees would be expected to occur. The Proposed Action includes a measure, Proposed Article 513, to develop and implement a bald eagle nest management plan for known nest sites (refer to Conservation Measures, below). This plan would address acceptable buffers and human activity and noise limits during the breeding season.

*Upstream Passage and Connectivity Upgrades:* Existing upstream passage facilities on the Lower Baker River would be replaced with new attraction, capture, and transport facilities. The facilities would likely be constructed within areas already occupied by project facilities or otherwise disturbed by riprap and parking areas.

Implementation of the upstream passage facilities would not be expected to affect nesting bald eagles. No bald eagle nest sites have been documented in the vicinity of the site; the closest nest site is approximately 1.5 miles away along the Skagit River.

Construction of the upstream passage facilities would generate noise from heavy equipment and would involve human activity at the site for a period of relatively short duration. Short-term effects could include displacement of bald eagles that may perch or forage in the vicinity of the construction site.

No overstory trees are expected to be removed for construction of the upstream passage facilities. Therefore, no removal of bald eagle perching or roosting habitat would occur.

A fishway to improve connectivity between Lake Shannon and Baker Lake would be installed in the Baker River or possibly Sulphur Creek, just downstream of the Upper Baker dam. Implementation of the fishway would not be expected to affect nesting bald eagles. No bald eagle nest sites have been documented in the vicinity of the site; the

closest nest site is more than 2 miles away at Maple Grove. Construction of the fishway would generate noise from heavy equipment and would involve human activity at the site for a period of relatively short duration. Short-term effects could include displacement of bald eagles that may perch or forage in the vicinity of the construction site. Few, if any, overstory trees would be expected to be removed for construction of the fishway. Therefore, it is unlikely that removal of significant amounts of bald eagle perching or roosting habitat would occur.

***Recreation Measures:*** Dispersed campsites are present around Baker Lake and Lake Shannon; several of these are located within 1,000 feet of existing bald eagle nest sites. The Proposed Action includes a measure to manage dispersed recreation and to implement management actions to limit adverse effects of dispersed recreation use, such as monitoring, maintenance, information, and hardening of dispersed campsites by formalizing the number of tent sites and providing toilet facilities. This measure would reduce human impacts at selected dispersed sites, potentially including sites in proximity to bald eagle nest sites.

Under the Proposed Action, management plans would be developed and implemented for bald eagle nest sites near the project and any winter night roost sites identified through surveys (proposed articles 513 and 512).

The Proposed Action includes measures to increase production of sockeye and Chinook (Proposed Article 101), increase efficiency of upstream and downstream migratory fish passage (proposed articles 103, 104, and 105), modify instream flows and ramping rates to benefit aquatic resources (Proposed Article 106), and manage LWD (Proposed Article 109). These measures are expected to increase levels of fish in the project reservoirs above current levels, providing an increase in available food resources for wintering and breeding bald eagles.

Proposed Article 106 would substantially increased minimum instream flows in the Lower Baker River, just upstream of the confluence with the Skagit River, and provides a schedule of ramping rates for the protection of aquatic resources. These modifications would benefit anadromous fish in the Skagit River downstream of the Baker River and would be expected to benefit bald eagles through increased food resource availability (refer to *Conservation Measures* below).

**Indirect Effects**—Over time, increased recreational use of project reservoirs and associated recreation sites may lead to increased levels of human disturbance of bald eagle nest sites and foraging areas. The Proposed Action includes a specific measure (Proposed Article 513) to develop bald eagle management plans that would protect

known and newly discovered nest sites and winter roost areas from human disturbance during the term of the new license (see *Conservation Measures* below).

**Cumulative Effects**—Bald eagle use of the Baker River basin is limited to the project reservoirs and nearby forested habitats. The Baker River Project supports an average of two pairs of breeding bald eagles by providing two year-round water bodies with suitable food resources and adjacent nesting sites. Wintering bald eagles use the project reservoirs in small to moderate numbers. Historical breeding and winter use data are not available for comparison with current use levels.

Future use of the basin would not likely modify bald eagle habitat or prey base. Lands surrounding Baker Lake would continue to be managed in the future for late successional and old-growth forest values. This management would protect forested habitats, perch trees, and fisheries resources. Lands surrounding Lake Shannon would continue to be managed for timber production; shoreline areas and streams would continue to be protected under state regulations. As discussed above, recreational pressure would likely increase in the future; however, future recreational development would be managed under specific project measures.

**Conservation Measures**—Puget would develop bald eagle management plans for known and newly discovered nest and winter roost sites on project land and lands acquired under the new license (Proposed Article 513). The plans would be designed to protect nest and winter roost sites from human disturbance during the sensitive nesting period per federal and state management guidelines (FWS, 1986; Watson and Rodrick, 2002). Surveys for bald eagle communal winter night roosts would be conducted in the vicinity of the project under Proposed Article 512. Two sets of surveys would be conducted during the term of the new license, under the direction of the TRIG. If winter roost sites are identified, site management plans would be developed and implemented to protect them from human disturbance. Selected dispersed recreation sites would be managed for protection of natural resources under Proposed Article 308.

Measures to protect, mitigate, and enhance aquatic resources would be implemented under the Proposed Action. Proposed Article 101 would provide fish propagation and enhancement programs and facilities, including supplementation programs for coho and Chinook salmon, and/or rainbow trout, and expansion of the current sockeye salmon supplementation program through construction of an upgraded spawning beach and new hatchery facility. Upstream and downstream passage for migratory fish would be enhanced through development of improved facilities and through study and implementation of measures to improve connectivity between the reservoirs (proposed articles 103, 104, and 105). A flow management regime would be implemented for the project addressing minimum instream flows, ramping, amplitude,

and cycling below each development (Proposed Article 106). This program would benefit fish and other aquatic resources downstream of the project, in the Skagit River basin. In combination, these measures would result in increased levels of fish resources in the project area, relative to current conditions, and would enhance potential food resources for bald eagles.

**Determination of Effect**—Implementation of the Proposed Action may benefit bald eagles by increasing protection of existing nest sites, existing riparian perching and foraging habitat, and communal winter night roosts (if present), and by enhancing fish prey base through a variety of actions. Short-term, temporary noise and human disturbance of habitats that could be used by bald eagles for foraging and perching would occur during construction of the Lower Baker powerhouse and aquatic facilities for downstream passage, upstream passage, connectivity, and fish propagation. Most of these facilities would be constructed in areas already cleared of vegetation; however, some loss of small numbers of overstory trees that could provide perching habitat may occur. Conservation measures would be implemented to protect bald eagle nest sites and communal winter night roosts from human disturbance and to enhance fisheries resources. The Proposed Action may affect, but would not likely adversely affect, individuals or populations of bald eagles.

**Marbled Murrelet**

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct Effects**—Ten "occupancy" sites have been documented in the Baker River basin (WDFW, 2004); the majority of these were recorded in the early 1990s and have not been resurveyed since that time. Two of the occupancy sites are located within approximately 0.25 mile of the project boundary along the southeastern shore of Baker Lake; the remaining eight sites are greater than 1 mile from the project boundary. The current status of murrelets in the basin is unknown. Critical habitat for the murrelet has been designated in the basin, coincident with the Forest Service LSRs.

***Reservoir Levels and Project Releases:*** Reservoir operations and project releases to be implemented under the Proposed Action would not directly affect marbled murrelets. Murrelets feed in marine waters and do not use fresh water systems. Reservoir operations could influence murrelet critical habitat adjacent to the Baker Lake reservoir if suitable nest trees are lost through individual mortality or erosion of the shoreline. The reservoir operations scenario to be implemented under the Proposed Action would result in overall erosion potential for the shorelines and drawdown zones of the reservoirs similar to the current condition (refer to section 3.3.1.2). An Erosion

Control Plan would be implemented (Proposed Article 110) to prioritize erosion sites, evaluate erosion control measures, and adaptively manage the implementation of erosion control measures.

***Lower Baker Powerhouse Modification:*** Reconstruction of the Lower Baker powerhouse would not directly affect marbled murrelets or designated critical habitat. No murrelet sightings have been documented in the vicinity of the Lower Baker powerhouse. Lands at the southern end of Lake Shannon and the Lower Baker River are dominated by early and mid-seral forest habitats and are not designated critical habitat. Up to one acre of young seral stage deciduous forest would be cleared for powerhouse construction (refer to section 3.3.5.2). Suitable nesting habitat for marbled murrelet consists of mature and old-growth coniferous forest (FWS, 1997); the vegetation that would be cleared at the Lower Baker powerhouse site is not suitable nesting habitat for marbled murrelet. The closest suitable habitat for marbled murrelet is more than 4 miles from the powerhouse site.

***Aquatic Measures:*** The Proposed Action includes several measures for protection, mitigation, and enhancement of aquatic resources that would involve construction of new facilities (proposed articles 101, 103, 104, and 105). Refer to section 2.2 for a description of the construction activities, and section 3.3.5.2 for a summary of effects to terrestrial resources.

*Upper Baker Development FSC Construction and Launch Site:* Construction and use of the Upper Baker FSC construction and launch site would not be expected to affect nesting marbled murrelets. No nest sites have been documented in the FSC construction and launch site vicinity and the FSC construction and launch site itself would be located within habitats that do not provide suitable nesting opportunities for murrelet. The nearest known murrelet detection site is near Anderson Creek, approximately 0.5 mile from the FSC construction and launch site, on the east side of Baker Lake.

Loud noise associated with the FSC construction and launch site construction could potentially affect marbled murrelets nesting adjacent to the site. Suitable habitat, mature and old-growth coniferous forest, is located approximately 500 feet west and north of the FSC construction and launch site. These stands are interspersed with non-forested, early and mid-seral stage stands subjected to recent timber harvest (Hamer Environmental et al., 2004). Temporary increases in noise levels would occur as a result of heavy equipment and pile-driving activities during berm construction (November through early January), and from construction vehicles and activities during the construction of the FSC (one calendar year). Table 3-33 indicates that the injury threshold distance for marbled murrelet for pile drivers, which would be used at the FSC

construction and launch site, is 60 yards. No suitable habitat for marbled murrelet nesting is located within 60 yards of the FSC site.

A total of approximately 7 acres of habitat would be affected by construction of the Upper Baker FSC construction and launch site. The site would be located primarily within the reservoir drawdown zone, reed canarygrass, and previously disturbed habitats characterized by deciduous tree and shrub species. Although this site is located within designated critical habitat, clearing would not affect any habitat suitable for use by marbled murrelets.

In conjunction with downstream fish passage improvements, a series of stress relief ponds would be constructed along the Lower Baker River near its confluence with the Skagit River. The ponds would be installed within the Lower Baker compound area, which is highly disturbed and mostly non-vegetated.

Construction of the stress relief ponds would not affect marbled murrelets or designated critical habitat. No murrelet sightings have been documented in the vicinity of the Lower Baker River. Lands at the southern end of Lake Shannon and the Lower Baker River are dominated by early and mid-seral forest habitats and are not designated critical habitat.

*Lower Baker Development FSC Construction and Launch Site:* Construction activities at this site would be of similar type and duration as described above for the Upper Baker FSC construction and launch site. Construction of the Lower Baker FSC construction and launch site would occur several years after completion of the installation of the Upper Baker FSC construction and launch site; no overlap in construction periods is expected.

Construction and use of the Lower Baker FSC construction and launch site would not affect marbled murrelets or designated critical habitat. No murrelet sightings have been documented in the vicinity of the FSC construction and launch site. Lands at the southern end of Lake Shannon are dominated by early and mid-seral forest habitats and are not designated critical habitat.

*Fish Propagation and Enhancement Programs and Facilities:* Under Proposed Article 101, Sockeye Spawning Beach 4, located near the confluence of Sulphur Creek and the Baker River, would be improved. All improvements would occur within the existing special use permit area, which is dominated by constructed facilities and adjacent, cleared and disturbed habitats. A new hatchery facility would be constructed within the footprint of the existing facility.

Construction of the improved Spawning Beach 4 and the new hatchery would not affect nesting marbled murrelets at the Sulphur Creek site. No murrelet sightings have been documented in the vicinity of Sulphur Creek. The site has been cleared previously and is dominated by vegetation typical of disturbed habitats. No trees suitable for use by nesting murrelets would be removed.

Loud noise levels from heavy equipment could potentially disturb marbled murrelets nesting adjacent to the site. Suitable habitat, mature and old-growth coniferous forest, is present approximately 200 feet away from the special use permit area at the Sulphur Creek site. These stands are interspersed with non-forested, early, and mid-seral stage stands subjected to recent timber harvest (Hamer Environmental et al., 2004). Temporary increases in noise levels would occur from use of heavy equipment during facility construction. Table 3-33 indicates that the injury threshold distance for marbled murrelet for heavy equipment, which would likely be used at the site, is 35 yards. No suitable murrelet habitat is located within 35 yards of the site.

Spawning beaches 1, 2, and 3 at the upper end of Baker Lake would be decommissioned, including restoration of vegetation along Channel Creek. Short-term increases in noise associated with this activity could potentially disturb marbled murrelets if nesting at or adjacent to the spawning beach site. No murrelet detections have been reported for the site; however, suitable mature and old-growth habitat is present at the site and in the surrounding area. Decommissioning of the site would be scheduled during the low water season, due to the need for instream work, and therefore, could potentially be scheduled outside of the murrelet breeding season. No removal of overstory trees would occur; therefore, no structural modification of critical habitat would occur.

*Upstream Passage and Connectivity Upgrades:* Existing upstream passage facilities on the Lower Baker River would be replaced with new attraction, capture, and transport facilities. The facilities would likely be constructed within areas already occupied by facilities or otherwise disturbed by riprapping and parking areas.

Construction of the upstream fish passage facilities would not affect marbled murrelets or designated critical habitat. No murrelet sightings have been documented in the vicinity of the Lower Baker River. Lands at the southern end of Lake Shannon and the Lower Baker River are dominated by early and mid-seral forest habitats and are not designated critical habitat.

A fishway to improve connectivity between Lake Shannon and Baker Lake would be installed in the Baker River or possibly Sulphur Creek, just downstream of the Upper Baker dam. Implementation of the fishway would not be expected to affect nesting marbled murrelets. No murrelet detections have been recorded in the vicinity.

Construction of the fishway would generate noise from heavy equipment and would involve human activity at the site for a period of relatively short duration. Short-term effects could include displacement of marbled murrelets from nesting habitats adjacent to the site. Suitable habitat for marbled murrelet, mature and old-growth forest stands, are present in the vicinity of Sulphur Creek and the Lower Baker Development. No overstory trees that provide suitable habitat for marbled murrelet are expected to be removed for construction of the fishway. Therefore, no direct effects to critical habitat for murrelet would occur.

***Recreation Measures:*** Dispersed campsites are present around Baker Lake and Lake Shannon; several of these are located within proximity of two documented murrelet occupancy sites. The Proposed Action contains a measure to manage dispersed recreation at three to six sites, to be determined in the future. The proposed article would implement management actions to limit adverse effects of dispersed recreation use, such as monitoring, maintenance, information, and hardening of dispersed campsites by formalizing the number of tent sites and providing toilet facilities. The measure would reduce human impacts at selected dispersed sites, potentially including sites in proximity to documented murrelet occupancy sites.

**Indirect Effects—** Project and non-project related human use would continue to occur in the basin under the Proposed Action and would increase gradually over time. Use of both developed and dispersed recreation sites is estimated to increase in the future. The extent to which human use affects murrelet nesting success is unknown. Murrelets nest high in the canopy and are reported to be not easily disrupted from nesting activity unless confronted at or near the nest (Long and Ralph, 1998). However, human activity near nest sites could increase the risk of predation of murrelets by ravens and Steller's jays (Marzluff et al., 2000, as cited in Hamer Environmental, 2003).

**Cumulative Effects—**Land uses in the Baker River basin are expected to remain the same during the term of the new license. Lands surrounding Baker Lake would continue to be managed primarily for late successional and old-growth forest habitat, and commercial timberlands surrounding Lake Shannon are expected to remain under timber management. Road densities are expected to remain at or near current levels, due to current state and Forest Service management measures for the protection of wildlife. These land uses would not likely contribute to cumulative adverse effects on marbled murrelets or their critical habitat. As noted above, recreation and human activity in the basin would likely increase gradually during the term of the new license.

**Conservation Measures—** Under the Proposed Action, two measures would be implemented that would provide protection and/or enhancement to marbled murrelets and designated critical habitat. First, under Proposed Article 308, Puget would thin

understory trees on 321 acres of second growth forest to promote the development of late seral forest characteristics. Second, under Proposed Article 308, Puget would harden three to six dispersed campsites to reduce recreation effects to previously documented murrelet occupancy sites, depending upon which recreation sites are selected for management. Garbage and waste management would reduce attractiveness of recreational sites to corvids and other potential predators of marbled murrelets.

**Determination of Effect—**The Proposed Action may affect, but is not likely to adversely affect, marbled murrelets and designated murrelet critical habitat. Minor clearing of vegetation in previously cleared and fragmented habitats would occur at the Sulphur Creek special use permit site, the fishway site, and the Upper Baker FSC launch site for the installation of aquatic resource facilities. Loud noise associated with heavy equipment and pile drivers could potentially cause short-term disturbance to murrelets using suitable habitat adjacent to these sites. The noise generated by construction would be temporary and intermittent.

**Northern Spotted Owl**

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct Effects—**Eight site centers for northern spotted owl have been documented in the Baker River basin (WDFW, 2004); the majority of these were recorded in the early 1990s and have not been resurveyed since that time. All of the site centers are located greater than one mile from the project boundary. The current status of northern spotted owl in the basin is unknown. Critical habitat for the spotted owl has been designated in the basin.

***Reservoir Levels and Project Releases:*** Reservoir operations and project releases under the Proposed Action would not directly affect spotted owls, as they are unlikely to use reservoir habitats. No nest site centers have been recorded within one mile of the project boundary. Reservoir operations could influence spotted owl critical habitat adjacent to Baker Lake if suitable nest trees are lost through individual mortality or erosion of the shoreline. The reservoir operations scenario to be implemented under the Proposed Action would result in overall erosion potential for the shorelines and drawdown zones of the reservoirs similar to the current condition (refer to section 3.3.1.2). An Erosion Control Plan would be implemented (Proposed Article 110) to prioritize erosion sites, evaluate erosion control measures, and adaptively manage the implementation of erosion control measures.

***Lower Baker Powerhouse Modification:*** Reconstruction of the Lower Baker powerhouse would not directly affect northern spotted owl or designated critical habitat. No spotted owl sightings have been documented in the vicinity of the Lower Baker Powerhouse. Lands at the southern end of Lake Shannon and the Lower Baker River are dominated by early and mid-seral forest habitats and are not designated critical habitat. Up to one acre of young seral stage deciduous forest would be cleared for powerhouse construction (refer to section 3.3.5.2). Suitable nesting habitat for northern spotted owl consists of mature and old-growth coniferous forest; the vegetation that would be cleared at the Lower Baker powerhouse site is not suitable nesting habitat. The closest suitable habitat for northern spotted owl is more than 4 miles from the powerhouse site.

***Aquatic Measures:*** The Proposed Action includes several measures for protection, mitigation, and enhancement of aquatic resources that would involve construction of new facilities (proposed articles 101, 103, 104, and 105). Refer to section 2.2 for a description of the construction activities, and section 3.3.5.2 for a summary of effects to terrestrial resources.

*Upper Baker Development FSC Construction and Launch Site:* Construction and use of the Upper Baker FSC construction and launch site is not expected to affect nesting northern spotted owls. No spotted owls have been documented in the FSC construction and launch site vicinity and the FSC construction and launch site itself would be located within habitats that do not provide suitable nesting opportunities for spotted owl. The nearest known spotted owl detection sites are in the upper Sandy Creek and upper Anderson Creek drainages, more than one mile from the FSC construction and launch site.

Loud noise associated with the FSC launch site construction could potentially affect northern spotted owls nesting adjacent to the site. Suitable habitat, mature and old-growth coniferous forest, is located approximately 500 feet west and north of the launch site. These stands are relatively small and are interspersed with non-forested and early seral stage stands subjected to recent timber harvest (Hamer Environmental et al., 2004). Temporary increases in noise levels would occur as a result of heavy equipment and pile-driving activities during berm construction (November through early January), and from construction vehicles and activities during the construction of the FSC (one calendar year). Table 3-33 indicates that the injury threshold distance for northern spotted owl for pile drivers, which would be used at the FSC construction and launch site, is 60 yards.

A total of approximately 7 acres of habitat would be affected by construction of the Upper Baker FSC construction and launch site. The site would be located primarily within reservoir drawdown zone, reed canarygrass, and previously disturbed habitats characterized by deciduous tree and shrub species. Although this site is located within

DCA boundaries, clearing would not affect any habitat suitable for use by northern spotted owl.

In conjunction with downstream fish passage improvements, a series of stress relief ponds would be constructed along the Lower Baker River near its confluence with the Skagit River. The ponds would be installed within the Lower Baker compound area, which is highly disturbed and mostly non-vegetated.

Construction of the stress relief ponds would not affect northern spotted owl or designated critical habitat. No spotted owl sightings have been documented in the vicinity of the Lower Baker River. Lands at the southern end of Lake Shannon and the Lower Baker River are dominated by early and mid-seral forest habitats and are not designated critical habitat.

*Lower Baker Development FSC Construction and Launch Site:* Construction activities at this site would be of similar type and duration as described above for the Upper Baker FSC construction and launch site. Construction of the Lower Baker FSC construction and launch site would occur several years after completion of the installation of the Upper Baker FSC construction and launch site; no overlap in construction periods would be expected.

Construction and use of the Lower Baker FSC launch site would not affect northern spotted owl or designated critical habitat. No spotted owl sightings have been documented in the vicinity of the launch site. Lands at the southern end of Lake Shannon are dominated by early and mid-seral forest habitats and are not designated critical habitat.

*Fish Propagation and Enhancement Programs and Facilities:* Under Proposed Article 101, Sockeye Spawning Beach 4, located near the confluence of Sulphur Creek and the Baker River, would be improved. All improvements would occur within the existing special use permit area, which is dominated by constructed facilities and adjacent, cleared and disturbed habitats. A new hatchery facility would be constructed within the footprint of the existing facility.

Construction of the improved Spawning Beach 4 and the new hatchery would not affect nesting northern spotted owl at the Sulphur Creek site. No spotted owl sightings have been documented in the vicinity of the Sulphur Creek. The site has been cleared previously and is dominated by vegetation typical of disturbed habitats. No trees suitable for use by nesting spotted owls would be removed.

Loud noise levels from heavy equipment could potentially disturb spotted owls nesting adjacent to the site. Suitable habitat, mature and old-growth coniferous forest, is present about 200 feet away from the special use permit area at the Sulphur Creek site. These stands are interspersed with non-forested, early-, and mid-seral stage stands subjected to recent timber harvest (Hamer Environmental et al., 2004). Temporary increases in noise levels would occur from use of heavy equipment during facility construction. Table 3-33 indicates that the injury threshold distance for northern spotted owl for heavy equipment, which would likely be used at the site, is 35 yards. No suitable habitat for spotted owl is present within 35 yards of the site.

Spawning beaches 1, 2, and 3 at the upper end of Baker Lake would be decommissioned, including restoration of vegetation along Channel Creek. Short-term increases in noise associated with this activity could potentially disturb northern spotted owl if nesting at or adjacent to the spawning beach site. No spotted owl detections have been reported for the site; however, suitable mature and old-growth habitat is present at the site and in the surrounding area. Decommissioning of the site would be scheduled during the low water season, due to the need for instream work, and therefore, could potentially be scheduled outside of the spotted owl breeding season. No removal of overstory trees would occur; therefore, no structural modification of critical habitat would occur.

*Upstream Passage and Connectivity Upgrades:* Existing upstream passage facilities on the Lower Baker River would be replaced with new attraction, capture, and transport facilities. The facilities would likely be constructed within areas already occupied by facilities or otherwise disturbed by riprapping and parking areas.

Construction of the upstream fish passage facilities would not affect northern spotted owl or designated critical habitat. No spotted owl sightings have been documented in the vicinity of the Lower Baker River. Lands at the southern end of Lake Shannon and the Lower Baker River are dominated by early and mid-seral forest habitats and are not designated critical habitat. A fishway to improve connectivity between Lake Shannon and Baker Lake would be installed in the Baker River or possibly Sulphur Creek, just downstream of the Upper Baker Dam. Implementation of the fishway is not expected to affect nesting northern spotted owls. No spotted owl detections have been recorded in the vicinity. Construction of the fishway would generate noise from heavy equipment and would involve human activity at the site for a period of relatively short duration. Short-term effects could include displacement of northern spotted owls from nesting habitats adjacent to the site. Suitable habitat for spotted owl, mature and old-growth forest stands, are present in the vicinity of Sulphur Creek and the Lower Baker Development. No overstory trees that provide suitable habitat for spotted owls would be

expected to be removed for construction of the fishway. Therefore, no direct effects to critical habitat for northern spotted owl would occur.

***Recreation Measures:*** The Proposed Action contains a measure to manage selected dispersed campsites at Baker Lake, using a specific measure to evaluate and control effects on natural resources. Presently, no dispersed campsites are known to be in close proximity to documented owl sighting locations.

**Indirect Effects**—Project-related human use would continue to occur in the basin, and would increase gradually over time under the Proposed Action. Selected dispersed campsites at Baker Lake would be managed using a specific measure to evaluate and control effects on natural resources (Proposed Article 308). The extent to which human use currently affects spotted owl nesting success is unknown.

**Cumulative Effects**—During the new license period, lands surrounding Baker Lake would continue to be managed for late successional and old-growth forest habitat. Commercial timberlands surrounding Lake Shannon are expected to remain under timber management. Road densities would likely remain at or near current levels, due to current and proposed wildlife management measures. These land uses are not expected to adversely affect spotted owls or their habitats. As noted above, recreation and human activity in the basin would likely increase gradually during the term of any new license issued.

**Conservation Measures**— Under the Proposed Action, two measures would be implemented that would provide increased protection and/or enhancement of spotted owl habitat. Under Proposed Article 515, Puget would thin the understory of trees on 321 acres of second growth forest in the Baker River watershed, to promote the development of late seral forest characteristics. Selected dispersed campsites at Baker Lake would be managed using a specific measure to control effects on natural resources (Proposed Article 308).

**Determination of Effect**—Implementation of the Proposed Action may affect, but is not likely to adversely affect northern spotted owls and designated northern spotted owl critical habitat. Minor clearing of vegetation in previously cleared and fragmented habitats would occur at the Sulphur Creek special use permit site, the fishway site, and the Upper Baker FSC launch site for the installation of aquatic resource facilities. Loud noise associated with heavy equipment and pile drivers could potentially cause short-term disturbance to spotted owls using suitable habitat adjacent to these sites. The noise generated by construction would be temporary and intermittent.

### Yellow-billed Cuckoo (Candidate)

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct and Indirect Effects**—Yellow-billed cuckoo and its habitat are not present in the Baker River basin. No direct or indirect effects on the species or its habitat would occur under the Proposed Action.

**Cumulative Effects**—The project has not contributed, nor would it contribute in the future, to cumulative effects on yellow-billed cuckoo or their habitats. Other actions expected to occur within the basin would not affect cuckoo, due to the lack of habitat.

**Conservation Measures**—No conservation measures are proposed for the protection of yellow-billed cuckoo.

**Determination of Effect**— The Yellow-billed cuckoo is a candidate species; therefore, no determination of effect is needed under the ESA. Nevertheless, implementation of the Proposed Action would have no effect on the yellow-billed cuckoo because this species is not present at the project.

### Canada Lynx

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct and Indirect Effects—**Canada lynx and its habitat are not present in the Baker River basin. No direct or indirect effects on lynx or lynx habitat would occur under the Proposed Action.

**Cumulative Effects**—The project has not contributed, nor would it contribute in the future, to cumulative effects on lynx or their habitats. Other actions expected to occur within the basin would not affect lynx, due to the lack of habitat.

**Conservation Measures**—No conservation measures are proposed for the protection of Canada lynx.

**Determination of Effect**—Implementation of the Proposed Action would have no effect on Canada lynx individuals or populations or their habitat.

**Fisher (Candidate)**

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct and Indirect Effects—**Fisher is believed to be extirpated from Washington State (Lewis and Hayes, 2004), and no sightings have been reported in Skagit or Whatcom counties since 1995 (WDFW, 2004). No direct or indirect effects to fisher would occur under the Proposed Action.

Suitable habitat for fisher is present in the Baker River basin. Mature and old-growth forests suitable for use by fisher would not be adversely affected by implementation of the Proposed Action. Project-related human use would continue to occur in the basin and would increase gradually over time under the Proposed Action.

**Cumulative Effects—**During the new license period, lands surrounding Baker Lake would continue to be managed for late successional and old-growth forest habitat. Commercial timberlands surrounding Lake Shannon are expected to remain under timber management. Road densities would likely remain at or near current levels, due to current and proposed wildlife management measures. These land uses are not expected to adversely affect fisher or their habitats. As noted above, recreation and human activity in the basin would likely increase gradually during the term of any new license issued.

**Conservation Measures—** Under the Proposed Action, one measure would be implemented that would provide increased protection and/or enhancement of suitable fisher habitat. Under Proposed Article 515, Puget would thin the understory of trees on 321 acres of second growth forest in the Baker River watershed, to promote the development of late seral forest characteristics.

**Determination of Effect—** The fisher is a candidate species; therefore, no determination of effect is needed under the ESA. Nevertheless, implementation of the Proposed Action would have no effect on the fisher because this species is not present at the project.

**Gray Wolf**

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct Effects—**The Proposed Action would not likely adversely affect gray wolves due to their infrequent occurrence in the Baker River basin. A small population

of wolves in the North Cascades to the east of the Baker River basin may be the source of occasional transient wolves that travel to the Baker River basin. No permanent population in the basin is known or suspected.

**Indirect Effects—**The Baker River Project could potentially influence the distribution of deer and elk in the basin; these species are primary food items for gray wolf. Human disturbance of ungulates could occur as a result of project operation and maintenance activities and project-related recreational activity. This disturbance could cause displacement of deer and elk from the sites of human activity. The Proposed Action includes a proposal to acquire and manage a minimum of 300 acres of elk forage habitat during the term of any new license issued (Proposed Article 503). Implementation of this measure would provide a reliable source of elk forage over the new license period. The action would contribute to the objectives established in the WDFW Nooksack Elk Herd Management Plan (Davison, 2002). This action could positively influence wolves over time by promoting a stable food source in the Baker River basin.

**Cumulative Effects—**Future use of the Baker River basin would not likely reduce habitat suitability for wolves. Lands surrounding Baker Lake would continue to be managed for late successional and old-growth forests. Lands surrounding Lake Shannon would continue to be managed for timber production. Road densities are not expected to increase due to current and proposed wildlife management objectives. These lands would continue to support deer and elk, which are primary wolf prey species. As noted above, recreation and human activity in the basin would likely increase gradually during the term of any new license issued.

**Conservation Measures—** Potential improvements in the abundance and stability of elk populations could occur through implementation of elk forage habitat management on a minimum of 300 acres of acquired land (Proposed Article 503).

**Determination of Effect**—Implementation of the Proposed Action may affect, but is not likely to adversely affect, gray wolves in the Baker River basin.

**Grizzly Bear**

We present the direct, indirect, and cumulative effects that would be expected to occur under the Proposed Action in the following subsections. Conservation measures and the overall effects determination are also described.

**Direct Effects—**The Proposed Action would not likely directly affect grizzly bears due to their infrequent occurrence in the Baker River basin. Only two grizzly bear

sightings have been documented over the past 15 years; both of these were greater than four miles from the project.

**Indirect Effects—** Potential foraging habitat for grizzly bears within the Baker BMU of the North Cascades Recovery Zone could be affected over time by increases in project and non-project related human activity. However, grizzly bears apparently do not use this habitat because of their infrequent occurrence in the Baker River basin.

**Cumulative Effects—**Future land uses in the Baker River basin are expected to remain consistent with current land uses. Lands surrounding Baker Lake would continue to be managed for late successional and old-growth forest habitat. Commercial timberlands surrounding Lake Shannon are expected to remain under timber management during the term of any new license issued. Road densities are expected to remain at or near current levels, due to current and proposed wildlife management measures. Recreation and human activity in the basin would likely increase gradually during the term of any new license issued.

**Conservation Measures—**None.

**Determination of Effect—**The Proposed Action may affect, but would not likely adversely affect, grizzly bears.

**Summary of Effect Determinations for Plant and Wildlife Species**

Table 3-34 summarizes ESA-listed terrestrial species evaluated, gives their listing status, and presents final effect determinations.

Table 3-34. Summary of effects determinations for ESA listed plant and wildlife species, and their designated critical habitat.

| Species | ESA Listing Status/Critical Habitat Designation | Effects Determination |
|---|---|---|
| Golden paintbrush (*Castilleja levisecta*) | Threatened | No Effect |
| Bald eagle (*Haliaeetus leucocephalus*) | Threatened (proposed for delisting) | May Affect, Not Likely to Adversely Affect |
| Marbled murrelet (*Brachyramphus marmoratus*) | Threatened | May Affect, Not Likely to Adversely Affect |
| | Designated critical habitat in Baker River basin | May Affect, Not Likely to Adversely Affect |

| Species | ESA Listing Status/Critical Habitat Designation | Effects Determination |
|---|---|---|
| Northern spotted owl (*Strix occidentalis* spp. *caurina*) | Threatened | May Affect, Not Likely to Adversely Affect |
| | Designated critical habitat in Baker River basin | May Affect, Not Likely to Adversely Affect |
| Canada lynx (*Lynx canadensis*) | Threatened | No Effect |
| Gray wolf (*Canis lupus*) | Threatened | May Affect, Not Likely to Adversely Affect |
| Grizzly bear (*Ursus arctos*) | Threatened | May Affect, Not Likely to Adversely Affect |

#### 3.3.6.3 Unavoidable Adverse Effects

Regardless of the collection efficiency level achieved by the new downstream fish passage systems, some project related mortality would occur to threatened and endangered fish species due to the handling required to collect and transport fish, and the inability to collect all emigrating fish during variable flow scenarios, and especially during extreme flow events.

Unavoidable, short-term increases in turbidity and minor water quality impacts are likely to occur as a consequence of the construction of the powerhouse facility, upstream passage facility upgrade, FSCs, passage facility for connectivity, fish propagation facility, and the spawning beach decommissioning. Puget would minimize the potential for water quality degradation through implementation of a water quality protection plan (Proposed Article 401). This would include adoption of appropriate best management practices for all activities.

In spite of the improvements to project facilities under the Proposed Action, the project would still have the potential for short-term rapid changes in river flow and daily flow fluctuations as a consequence of hydroelectric project operations. These flow fluctuations would result in the increased potential for stranding and redd dewatering.

### 3.3.7 Cultural Resources

Historic Properties are defined as sites, structures, buildings, districts, traditional places, or objects that are listed or are eligible for listing in the National Register (36 CFR 60). To be considered eligible for listing in the National Register, properties must possess integrity of location, design, setting, materials, workmanship, feeling and

association, and meet one or more of the following criteria: (A) be associated with events that may have a significant contribution to the broad patterns of our history; (B) be associated with the lives of persons significant in our past; (C) embody the distinctive characteristics of a type, period, or method of construction or that (1) represent the work of a master, (2) possess high artistic values, or (3) represent a significant and distinguishable entity whose components may lack individual distinction; and (D) have yielded or may be likely to yield information important in prehistory or history. In some cases, properties may qualify for the National Register by meeting certain criteria exceptions (36 CFR 60.4). Historic Properties identified through surveys would be managed under the provisions of the HPMP.

#### 3.3.7.1 Affected Environment

**Area of Potential Effect**

The Baker River Project Area of Potential Effect (APE) for archaeological resources and historic structures includes: (1) the area within the project boundary; (2) the area occupied by project facilities (including roads, stockpiles, and buildings) and formal camping facilities that lie within the project boundary and extend out beyond it; (3) the fluctuation zone of both reservoirs, *i.e.*, the area extending from the high-water line into the area exposed by drawdown; (4) a zone extending from the full pool mark (high-water line) to approximately 130 feet beyond the mark; (5) dispersed recreational sites that lie within a 0.25-mile zone beyond the reservoir full pool mark; (6) the area within a 100-foot-wide transect along the length of the Baker Lake Trail; and (7) areas delineated by drawing 328-foot (100 meter) polygons around the dispersed recreational sites, and drawing a line extending from the outlying edges of the polygons up to the Baker Lake Trail for those on the east side of Baker Lake. By letter dated February 4, 2003, the Washington OAHP concurred with this definition of the APE.

For ethnographic study purposes, consideration of traditional cultural properties encompassed the entire Baker River watershed with a focus on lands within the APE developed for archaeological and historic resources.

**Prehistoric and Historic Archaeological Resources**

There are no prehistoric or historic period archaeological resources, within the project's APE, that are currently listed in the National Register. Puget conducted an intensive archaeological survey of the project's APE and identified six early Holocene sites, two historic period sites, and one archaeological district that are eligible for listing in the National Register (Miss *et al*., 2004). The survey encompassed the entire APE. Survey methods varied for the APE in the drawdown zone and outside the drawdown. All accessible areas on the rim and 100 percent of the area within the exposed drawdown zones were examined if they did not present a safety hazard. All areas of high and

moderate probability and 10 percent of areas of low probability were examined in the forested areas, along Baker Trail, at dispersed campsites, and at project facilities. Probable areas were identified based on slope and proximity to various environmental and historic elements.

**Survey Results**

A total of 19 prehistoric archaeological resources were identified within the APE. Of these archeological resources, 10 are archeological sites, while the remaining 9 consist of isolated flake scatters or individual stone artifacts. Four sites (45-WH-647, 45-WH-584, 45-WH-586, and 45-WH-587) occur within the drawdown zone of Baker Lake and one site occurs within the drawdown zone of Lake Shannon (45-SK-252). One site (45-WH-636) extends from slightly above the maximum Baker Lake pool elevation. These six sites, located in or near the drawdown zones, consist of lithic scatters dating from the early Holocene period (10,800–5,000 Before Present).

During the period when surveys were conducted in 2001 and 2003, the drawdown varied from about elevation 382.5 feet msl to elevation 437 feet msl at Lake Shannon and from about elevation 685 feet msl to elevation 713 feet msl at Baker Lake. Operation of the reservoirs has the potential to reveal additional sites in areas not accessible during the surveys. On Lake Shannon, many terraces that may contain cultural material either were covered with silt or were under water during the surveys. Several locations where lithic flakes were found in the cut bank during the rim survey (45-WH-651, 45-W-652, and 45-WH-653) require further investigation.

The surveys identified 32 historic period archaeological resources. These historic period archeological resources consist of isolated artifacts, homestead and industrial artifact scatters, foundations, and other associated structural and surface remains such as roads and trails. At extremely low elevations (such as during drought conditions), project reservoirs may reveal additional historical sites. The original Baker Lake shoreline contained the original site of the Baker Lake Resort (1935 to about 1960), which was developed on the Ruuth Homestead (1891). Along the south shore of the lake was the Baker Lake Ranger and Guard Station situated on the John Eagletrout homestead, from 1911 to 1932. Near Noisy Creek was the Baker Lake Fish Hatchery, from about 1896 to 1940. During the period 1937–1938, a Civilian Conservation Corps camp was located near the fish hatchery to rebuild it after a fire. The location of the hatchery was not exposed during the field surveys and its exact location and condition are unknown.

The Mike Morovitz Homestead was located to the west of Baker Lake outside of the APE. A USGS map of 1915 shows a “Ranger Cabin” located along the east side of the Baker River south of Anderson Creek, above the current Upper Baker dam. This was the Forest Service Baker River Ranger Station that preceded the Koma Kulshan Guard

Station (listed in the National Register). The Baker River Railroad Bridge (1908–1925) crossed the river gorge just north of the current Lower Baker dam. General Land Office plats and other historical maps dating from 1881 to 1952 show a number of cabins along the river, in areas that were inundated by Lake Shannon and the current Baker Lake. The Baker River Railroad Bridge, which was located across the river near the current Lower Baker dam, was inundated by Lake Shannon.

Remnants of early industrial and agricultural development could be associated with these historical archaeological sites or might be found in other locations. Most prominent would be the remains of logging operations, such as railroad grades, trestle bridges, or debris from logging-campsites. This debris would likely consist of trash dumps, broken and discarded tools, pieces of old cable and rigging equipment, and sawdust piles. The potential for discovering the remains of permanent buildings in logging campsites is very low because most of the buildings—cook shacks, barracks, maintenance sheds—were moved from camp to camp. In addition, the debris from mining operations, tailings and the presence of old mineshafts could be found.

**National Register Status**

Based on the survey results Puget has prepared a determination of eligibility for a Baker River Archaeological District (Archaeological District). The Archaeological District is representative of the early human history in the Baker River Valley in the North Cascades Range and meets Criteria A and D. Under Criterion A, the Archaeological District has provided important data to help understand the prehistory of riverine and uplands adaptations in the Pacific Northwest. The record of the Baker River is especially important when considered in the light of the near absence of systematic study of similar settings. The prehistoric sites represent early settlement in the region with remains probably as old as 8,000 years. Under Criterion D, the Archaeological District has the potential for important research based on site assemblage that can provide data to address the research domains of chronology, technology, and settlement. Eligibility is based primarily on the potential to provide information about lithic technology, including toolstone selection, reduction, and manufacture. The Washington OAHP concurred with this eligibility determination on March 30, 2004.

The Archaeological District includes 18 contributing prehistoric sites (see table 3-35). Six of the contributing prehistoric sites (45-WH-647, 45-WH-584, 45-WH-586, 45-WH-587, 45-SK-252, and 45-WH-636) are also individually eligible. Four prehistoric contributing sites (45-WH-590, 45-WH-591, 45-WH-592, and 0605010024) require further investigation to determine whether they are individually eligible. One prehistoric site (0605010060) does not contribute to the Archaeological District. All of the eligible archaeological sites are subject to the ongoing effects of shoreline erosion. At publicly accessible locations, surface collecting also is an ongoing problem affecting site integrity.

The APE includes two eligible historic period archaeological sites consisting of a lithic scatter and homestead logging camp (45-SK-252; historic component) dating from the late nineteenth century and a homestead site (45-SK-253) dating from the late nineteenth to early twentieth century. These sites also are recommended as eligible under Criterion D. Nine of the identified historic archaeological sites require further identification/assessment (45-WH-580/581, 45-WH-585, 45-WH-642, 45-WH-657, BR 0150, 45-SK-249, 45-SK-250, 45-SK-251, and 45-SK-290 (see table 3-35.)

Table 3-35. Eligible prehistoric and historic archaeological resources. (Source: Northwest Archaeological, 2004)

| No. | Site Description | National Register Status | Threats | Management Recommendation |
|---|---|---|---|---|
| **Prehistoric Archaeological Resources** | | | | |
| 45WH582 | Lithic scatter | Contributing | Erosion | Complete evaluation |
| 45WH584 | Lithic scatter | Eligible, Contributing | Erosion and unauthorized artifact collection | Data recovery with emphasis on surface collection |
| 45WH586 | Lithic scatter | Eligible, Contributing | Erosion and vandalism | Data recovery with emphasis on surface collection |
| 45WH587 | Lithic scatter | Eligible, Contributing | Erosion and unauthorized artifact collection | Data recovery with emphasis on surface collection |
| 45WH588 | Lithic scatter | Contributing | Erosion and unauthorized artifact collection | Complete evaluation |
| 45WH589 | Isolate, edge modified piece | Contributing | Erosion | Complete evaluation |
| 45WH590 | Isolate, modified cobble | Pending,[a] Contributing | Erosion | Complete evaluation when reservoir is drawn down near minimum pool |
| 45WH591 | Isolate, core | Pending,[a] Contributing | Erosion | Complete evaluation when reservoir is drawn down near minimum pool |

| No. | Site Description | National Register Status | Threats | Management Recommendation |
|---|---|---|---|---|
| 45WH592 | Isolate, modified cobble | Pending,[a] Contributing | Erosion | Complete evaluation when reservoir is drawn down near minimum pool |
| 45WH593 | Isolate, flake | Contributing | Erosion | None |
| 45WH636 | Lithic scatter | Eligible, Contributing | Erosion and unauthorized artifact collection | Data recovery with emphasis on surface collection |
| 45WH647 | Lithic scatter | Eligible, Contributing | Erosion and unauthorized artifact collection | Data recovery with emphasis on surface collection |
| 45WH650 | Isolate, flakes | Contributing | Erosion | Complete geomorphologic study and annual monitoring |
| 45WH651 | Isolate, flake | Contributing | Erosion | Complete geomorphologic study and annual monitoring |
| 45WH652 | Isolate, flakes | Contributing | Erosion | Complete geomorphologic study and annual monitoring |
| 45WH653 | Isolate, flakes | Contributing | Erosion | Complete geomorphologic study and annual monitoring |
| 45SK252 | Lithic scatter | Eligible, Contributing | Inundated by Lake Shannon | Complete evaluation |
| 0605010024 | Lithic scatter | Pending,[a] Contributing | Previously recorded but not relocated | Complete evaluation if relocated |
| **Historic Archaeological Resources** | | | | |
| 45WH580 /581 | Camp 1880–1925 | Pending | Inundated by Baker Lake | Complete evaluation when reservoir is drawn down near minimum pool. |
| 45WH585 | Ruuth Homestead, Old Baker Lake Resort | Pending | Inundated by Baker Lake | Complete evaluation when reservoir is drawn down near minimum pool |

| No. | Site Description | National Register Status | Threats | Management Recommendation |
|---|---|---|---|---|
| 45WH642 | Road, bridge, debris scatter | Pending | Inundated by Baker Lake | Complete evaluation when reservoir is drawn down near minimum pool |
| 45WH657 | Anderson Butte Trail | Pending | Inundated by Baker Lake | Complete evaluation when reservoir is drawn down near minimum pool |
| BR0150 | Baker Lake fish hatchery | Pending | Operation and maintenance activities | Complete evaluation |
| 45SK116th | Baker River Bridge | Listed | Operation and maintenance activities | None |
| 45SK249 | Railroad trestle | Pending | Inundated by Lake Shannon | Complete evaluation when reservoir is drawn down near minimum pool |
| 45SK250 | Debris scatter | Pending | Inundated by Lake Shannon | Complete evaluation when reservoir is drawn down near minimum pool |
| 45SK251 | Industrial debris | Pending | Inundated by Lake Shannon | Complete evaluation when reservoir is drawn down near minimum pool |
| 45SK252 | Weston homestead, logging camp | Eligible | Erosion | Data recovery with emphasis on surface collection |
| 45SK253 | Edgar Homestead | Eligible | Erosion and unauthorized artifact collection | Monitor for erosion and vandalism |
| 45SK290 | Isolate, stove leg, ceramic fragment | Pending | Inundated by Lake Shannon | Complete evaluation when reservoir is drawn down near minimum pool |

| No. | Site Description | National Register Status | Threats | Management Recommendation |
|---|---|---|---|---|
| Note:<br>Eligible–Determined eligible for listing in the National Register.<br>Contributing–Contributes to the archaeological values of a district.<br>Pending–Additional investigation and evaluation required.<br>[a] These sites contribute to the District but require further investigation to determine if they are individually eligible. | | | | |

### Historic Buildings and Structures

Two historic structures within the project's APE are currently listed in the National Register: the Lower Baker River Hydroelectric Power Plant and the Baker River Bridge.

The Lower Baker River Hydroelectric Power Plant was listed on July 17, 1990, as part of a multiple property nomination process for hydroelectric power plants in Washington State from 1890 to 1928. The property represents an example of medium-head hydroelectric technology from the 1920s and meets Criterion C. The nomination form identifies the dam, intake, main pressure tunnel, circular forebay or surge chamber, branch tunnel, and penstocks, all constructed between 1925 to 1929, as contributing elements. The Lower Baker powerhouse and surge tank, which were completed in 1969 to replace the original powerhouse that was destroyed by a landslide, are not contributing elements. The nomination form did not address auxiliary resources including company housing, maintenance, and warehouse facilities.

The Baker River Bridge (1916) was listed on May 4, 1975, as part of a multiple property nomination process for historic tunnels and bridges of Washington State. The bridge is an example of a long-span reinforced concrete arch that was used in highway bridge construction (Forest Service, 2002a). The bridge is located about 0.5 mile upstream from the confluence of the Baker and Skagit Rivers.

Puget surveyed the project's APE for historic properties and identified 19 structures and buildings that contribute to two proposed historic districts associated with the project: (1) the Baker River Hydroelectric Development Historic District and (2) the Washington Portland Cement Company Historic District.

### Baker River Hydroelectric Development Historic District

Puget Sound Power & Light Company (Puget Power, now Puget Sound Energy) developed the Baker River's potential for hydroelectric power when it built the Lower Baker Development between 1924 and 1929. Construction of the dam was in response to

increasing development in the Puget Sound region and the need to meet increasing peak power demands.

World War II further encouraged growth in the Puget Sound region, resulting in an increase in population and the development of infrastructure in Bellingham, Everett, Seattle, and Tacoma. To accommodate continued growth, Puget Power decided during the early 1950s to install a third 64,000-kilowatt unit in the existing Lower Baker powerhouse, while also constructing a second hydroelectric dam on the upper river. This expansion reflected a region-wide trend in water resources development. Work on the Upper Baker Development began in 1956 and was completed in 1959. In 1965, a landslide destroyed a large part of the Lower Baker powerhouse, which Puget reconstructed in 1968 with a structural design to withstand future slides.

The active management of fishery resources on the Baker River began at the end of the nineteenth century when the Washington State hatchery, located on Silver Creek along the south shore of Baker Lake, began propagating sockeye in 1896. The original facility included several buildings. Three years later, the U.S. Fish Commission (now FWS) assumed control of this facility. Biological investigations conducted at this facility were part of a regional effort to protect fisheries valuable for commercial and sport harvests. The hatchery burned three times during the early twentieth century. The hatchery ceased sockeye production in 1933, due to poor adult escapement, and closed in 1937.

This early concern about fishery resources led to the construction of fish passage facilities when the Lower Baker Development and later, the Upper Baker Development, were built. We discuss fish passage facilities in the Existing Fish Facilities and Programs section. Fish passage facilities constructed as part of the Lower and Upper Baker Developments document the process of experimentation in fish handling, resulting in the protection and enhancement of fishery resources in the Pacific Northwest. HRA (2000) provides an extensive account of this "working laboratory."

The Baker River Hydroelectric Development Historic District (Hydroelectric District) includes seven contributing elements from the Lower Baker Development with character-defining features that link the architectural and engineering design elements of Lower Baker to the 1920s and the rapid expansion of the regional power market that defined that era. An additional five contributing elements from the Upper Baker Development are included in the Hydroelectric District with character-defining features that provide evidence of the early phases of fish passage experimentation. Together, the contributing elements in Hydroelectric District include the: (1) Lower Baker dam and ski-jump spillway; (2) Lower Baker fish rack; (3) Lower Baker barrier dam; (4) Lower Baker fish trap; (5) Lower Baker barge (gulper) and pass-through pipeline; (6)

superintendent housing at 7214 Baker River Road; (7) superintendent housing at 7208 Baker River Road; (8) Upper Baker dam; (9) Upper Baker powerhouse; (10) Upper Baker barge (gulper) and pass-through pipeline; (11) Spawning Beach 1; and (12) Spawning Beach 2 (see table 3-36).

The period of significance for the Hydroelectric District would extend from the project design in 1924 to completion of the Upper Baker dam and Spawning Beach 2 in 1959. The Hydroelectric District is eligible for listing in the National Register under Criteria A and C for its significant association with both American conservation and engineering. The Washington OAHP concurred with this eligibility determination by letter dated March 25, 2004. Both the report prepared for the Hydroelectric District that was submitted to Washington OAHP for concurrence and the project's HPMP provide detailed discussions of the history of the facilities and the character-defining contributing components.

**Washington Portland Cement Company Historic District**

Amasa Everett's discovery in 1891 of clay and limestone deposits north of present-day Town of Concrete led to the rapid development of the towns of Baker and Cement City, which in 1909 merged to form the Town of Concrete. The Washington Portland Cement Company, located on the east bank of the Baker River, operated from 1905 until circa 1920, when it was purchased by its local competitor, Superior Portland Cement Company and abandoned. During its period of operation, the Washington Portland Cement Company plant included a rotary kiln room, kiln bins, a grinding room, a ball mill room, crushers, a rotary dryer room, and a clay storage area. Conveyors transported materials between buildings, and to and from auxiliary buildings and rail lines. A powerhouse and boiler room were located just north of the complex, and offices, boarding rooms, and bunkhouses were sited on the northwest and southeast edges of the property. Washington Portland Cement Company was designed to incorporate one of the most important features of twentieth century cement production - the ability to provide a continuous flow of concrete within a plant (Emmons *et al*., 2004).

Although many of the resources associated with cement production have been removed, surviving resources retain sufficient integrity to convey their historic significance (Emmons *et al*., 2004). These resources are eligible for listing in the National Register as part of the Washington Portland Cement Company Historic District (Cement Company District) for their significant association with American industry and engineering (Criteria A and C). The period of significance extends from 1905, when the plant was developed, until circa 1920, when it was purchased and dismantled by its competitor. Seven contributing elements to the Cement Company District include the: (1) cement silos; (2) warehouse; (3) concrete storage bin; (4) conveyor system pillar; (5) club house at 46174 East Main Street; (6) company housing at 46207 East Main Street;

and (7) company housing garage (table 3-36). Together, these resources encompass some of the major components necessary for early twentieth-century cement production, and their existence directly influenced the settlement and growth of the Town of Concrete. The Washington OAHP concurred with this eligibility determination by letter dated March 25, 2004.

Table 3-36. Properties contributing or non-contributing to the historic districts. (Source: Northwest Archeological, 2004)

| **Element** | **Status** |
|---|---|
| **Baker River Hydroelectric Development Historic District (1924–1959)** | |
| Lower Baker dam and ski-jump spillway (1924–1925) | Contributing structure (listed on the National Register) |
| Lower Baker fish rack (1925) | Contributing structure |
| Lower Baker barrier dam (1957) | Contributing structure |
| Lower Baker fish trap (1957) | Contributing structure |
| Lower Baker powerhouse and surge tank (1968) | Noncontributing structures |
| Lower Baker barge (gulper) and pass-through pipeline (1959) | Contributing structure |
| Lower Baker commissary, warehouse/garage (1924) | Noncontributing structure |
| Lower Baker Development "Loci" shed and shops (1924) | Noncontributing structures |
| Superintendent housing at 7214 Baker River Road (ca. 1924) | Contributing building; individually eligible |
| Superintendent housing at 7208 Baker River Road (ca. 1924) | Contributing building; individually eligible |
| Upper Baker dam (1959) | Contributing structure |
| Upper Baker powerhouse (1959) | Contributing structure |
| Upper Baker barge (gulper) and pass-through pipeline (1959) | Contributing structure |
| Spawning Beach 1 (1956–1957) and Spawning Beach 2 (1959) | Contributing structures (2) |
| Spawning Beach 3 (1966) | Noncontributing structure |
| **Washington Portland Cement Company Historic District (1914–1925)** | |
| Cement storage silos (1914) | Contributing structure |
| Warehouse (1914) | Contributing building |
| Warehouse #3 (pre-1925) | Noncontributing building |
| Concrete storage bin (1920) | Contributing building |
| Garage (pre-1929) | Noncontributing building |
| Conveyor system pillar (pre-1912) | Contributing structure |
| 46174 East Main Street Club House (1914) | Contributing building |
| 46207 East Main Street Company Housing (1915) | Contributing building |
| Company housing garage (ca. 1915) | Contributing building |

### *Traditional Cultural Properties and Sacred Sites*

#### Traditional Use of the Baker River Valley

Several Indian tribes have used areas within the vicinity of the project. The Upper Skagit Indian Tribe comprises bands that lived along the Skagit, Cascade, and Baker Rivers and their tributaries. Since 1915, these bands have constituted a single tribe. The Sauk-Suiattle lives to the southeast, and the aboriginal territory of the Nooksack borders the Upper Skagit to the north. The N'lakapamux, or Thompson Indians, of British Columbia include a small portion of the Upper Baker River within their territory. The project is in the ethnohistoric territory of the Northern Lushootseed-speaking Upper Skagit. The Swinomish Tribal Indian Community is composed mostly of descendents of Skagit, Kikiallis, Swinomish, and other groups. The Swinomish Reservation, located at the mouth of the Skagit River, was created by the Treaty of Mukilteo in 1855 and provides a land base for people whose ancestors lived in the Baker Valley (Bush, 2004).

Before contact with Euro-Americans altered the aboriginal lifestyle, Indian settlement and land use in the vicinity of the project was based on a seasonal resource harvest, with salmon fishing as most important, followed by hunting and plant gathering. Groups maintained permanent winter villages along major rivers at the mouths of tributaries. Each village consisted of one or more large longhouses made from split-cedar planks and a number of associated smaller buildings. Although the villages were primarily occupied during the colder months of the year, family groups visited them frequently throughout the year to bring preserved foods they had harvested, and many of the villages were never entirely deserted.

Villages were home to extended family groups and represented an economic, social and political kinship unit. During the spring, summer, and fall, smaller family groups traveled to various locations to join groups from other winter villages in fishing, root harvesting, hunting, berry picking, and other economic pursuits (Hollenbeck, 1987). These activities were carried out from temporary camps that may have been reused seasonally (Collins, 1973; Blukis-Onat and Hollenbeck, 1981).

The large winter villages were politically autonomous, although cultural, linguistic and kinship ties existed among them. The largest and socially dominant upriver village of the Skagit Peoples was the S.baliqw centered around the current Town of Concrete, including Baker River and natural Baker Lake and extending along the Skagit River (Bush and Green, 2004). The common practice of intermarriage and the cooperative use of resource gathering areas resulted in relationships among villages in separate drainages. Kinship and marriage conferred rights to share in resource harvest in other areas, resulting in frequent travel along streams and ridge tops, between river valleys and even across the Cascade Mountains (Hollenbeck, 1987).

The spiritual life of the Upper Skagit Indians, like that of other northern Puget Sound groups, centered on guardian spirits, other spirit beings, souls, and omens. Shamans were specialists in these affairs; however, any individual could undertake a quest to obtain a guardian spirit. During these quests, an individual would travel upriver and into the mountains, often to a particular place, for a specific period (Blukis-Onat and Hollenbeck, 1981). Although religion and ritual permeated everyday life, the most important rituals were associated with birth, puberty, marriage, and death.

Several resources were important for rituals, including cedar trees, a variety of medicinal and utilitarian plants, and specific foods. Cedar was especially important because it provided materials for most ritual activities. In addition to the species of plant, the location where it was gathered was also considered to influence the efficacy of the ritual. Some areas with particular plants were considered to have religious importance (Blukis-Onat and Hollenbeck, 1981).

These types of religious beliefs and practices have seen a recent revival among Indian tribes (Blukis-Onat and Hollenbeck, 1981). Such beliefs and practices were once bound to specific territories, based on kinship rights. Modern practitioners of Northwest Tribal religions often emphasize the significance of areas that today remain relatively unaltered and accessible to elders. Thus, tribal members often use areas outside their aboriginal territories. Because these areas are limited, members from more than one tribe may use them.

Federally recognized tribes in the Baker River Project area include the Upper Skagit Indian Tribe, the Sauk-Suiattle Indian Tribe, the Swinomish Indian Tribal Community, and the Samish Tribe. Of these tribes, the Upper Skagit, Sauk-Suiattle, and Swinomish have been extensively involved in the relicensing process for the project.

### Traditional Cultural Properties

No traditional cultural properties listed or recommended as eligible for listing in the National Register have been identified in the project area (Bush, 2004). However, in the interest of long-term partnership in managing cultural resources, Puget acknowledges that the project APE is an area of special concern for the tribes. Through collaborative discussion and consultation with the tribes, valuable information has been provided by identification of critical areas and effects associated with the project. Puget conducted a series of meetings with the Upper Skagit Indian Tribe, the Swinomish Indian Tribal Community, and the Sauk-Suiattle Indian Tribe to provide information concerning the identification and management of cultural resources and technical support for the implementation of the tribes' oral history projects. As part of this process, a comprehensive cultural archive of over 300 documents was collated and provided to each

tribe in 2004. This archive served as the basis for the development of an ethnographic overview of the Baker River basin that provides a conceptual framework for identifying and managing traditional cultural properties in the project area (Bush, 2004).

The Status of Traditional Cultural Property Investigations lists archaeological site types and potential traditional cultural property site types that would be expected to occur in the project area. Archaeological site types include lithic scatters, cultural depressions, culturally modified trees, rock art, earthworks, petroforms, human remains, and burials. Potential traditional cultural property site types include gathering areas for functional, medicinal, and food plants; private knowledge areas for ceremonial and spiritual activities; fishing areas for salmon, steelhead, and other fish; hunting areas for bear, beaver, deer, elk, mountain goat, grouse, and waterfowl; villages; social gathering areas; encampments for travel; trails; and burial sites (Bush, 2004).

The status report includes management area definitions for critical areas associated with the archaeological and traditional cultural property site types. Critical areas may have eligible properties within them, require additional data collection, may require mitigation for development to proceed, require consultation, may have higher planning and development costs, and are perceived to be impossible to trade or multiuse (Bush, 2004). Each tribe would develop and maintain custody of maps showing the critical areas in relation to developments in the project area. The HPMP provides for incorporation of information and measures for eligible traditional cultural properties that may be identified in the future.

#### 3.3.7.2 Environmental Effects

**Effects of Project Operations and Reservoir Level Management**

The project's reservoirs inundated an undetermined number of sites associated both with the earliest inhabitants of the area and with the pre-1925 industrial development in the area. Baker Lake also inundated the location of the original Baker Lake Resort.

Operation of the project causes water level fluctuations in Baker Lake and Lake Shannon. Fluctuating water levels can erode sites located along the shoreline, including submerged terraces. Measures identified under the Proposed Action (Proposed Article 106 and Proposed Article 107) would affect reservoir elevations: (1) implementation of a new reservoir management regime that takes into account terrestrial, recreational, aquatic, and cultural resources; (2) maintenance of the current level of flood control at the Upper Baker Development; and (3) restrictions on drawdown of Lake Shannon and Baker Lake below elevations of 389 feet and 685 feet msl, respectively, to enhance water quality; and (4) operation of Lower Baker Reservoir to provide up to 29,000 acre-feet of storage for flood regulation, at the direction of the Corps.

*Effects Analysis*

Potential shoreline erosion is analyzed in the Geology and Soils section. This analysis indicates that daily and seasonal water level fluctuations under the Proposed Action would cause erosion similar to that which is occurring under current conditions. Around Baker Lake, high pool cut-banks undergoing active erosion are experiencing mass wasting in the form of block topple or slump due to undercutting at the base of the scarp (AESI, 2003). Therefore, erosion of eligible archaeological resources along the shoreline and within the drawdown zone would continue under the Proposed Action. At Lake Shannon, the analysis in this draft EIS indicates that under the Proposed Action there would be little change in effects from daily and seasonal water level fluctuations on the erosion potential along the shoreline and within the drawdown zone. Almost all high pool cut-banks undergoing erosion around Lake Shannon are experiencing similar erosion as are occurring at Baker Lake. Therefore, erosion of eligible archaeological resources along the shoreline and within the drawdown zone may continue under the Proposed Action in a manner similar to current conditions.

Shoreline erosion of historic properties could also occur from public access and recreational use. Implementation of an Erosion Control Plan, in concert with the HPMP, would minimize soil erosion thereby protecting historic properties.

**Effects of Project Operations and Releases**

Under the Proposed Action, Puget would release an instream flow of 1,000 cfs from August 1 through October 20 and 1,200 cfs from October 21 through July 31 in the Baker River downstream of the project as measured at the Baker River at Concrete gage and restrict downramp rates to no more than 650 cfs per hour (Proposed Article 106). An instream flow of 1,000 to 1,200 cfs represents an increase of 920 to 1,120 cfs over the current instream flow release of 80 cfs. See section 2.0, Proposed Action and Alternatives, for further discussion.

*Effects Analysis*

Archaeological surveys did not identify any prehistoric or historic archeological sites or any traditional cultural properties downstream of the project that could be affected by higher minimum flows. Therefore, project releases would not affect any known historic properties.

**Ongoing Cultural Resource Needs**

The Proposed Action includes significant construction, long-term maintenance activities, and would likely increase recreation in the APE. To protect historic properties,

Puget proposes: (1) implementation of the Programmatic Agreement and HPMP (Proposed Article 201), and (2) funding for cultural resources enhancement (Proposed Article 602). These efforts would be coordinated with the tribes and other interested parties concerned about historic properties affected by the project.

**Historic Properties Management Plan**

Puget developed an HPMP in consultation with the SHPO, Forest Service, the tribes, and other interested parties to protect historic properties at the project. The HPMP was filed on November 18, 2004, as Volume III of the license application.

The HPMP provides for: (1) individual management measures for each Historic Property, including specific protective and mitigation measures, guidelines for maintaining historic buildings and structures, and measures for avoiding effects on traditional cultural properties; (2) clearly defined policies and programs that provide for all aspects of cultural resource management, including project review and planning, Tribal coordination, assessment of new actions, a listing of excluded actions, measures to be undertaken in cases of emergency or accidental discovery of cultural material or human remains, and procedures for curation of cultural material and samples; (3) provisions for protecting known sites including annual monitoring and sponsorship of law enforcement training and presence; (4) provisions for training and education for Puget personnel about the cultural heritage of the project and for outreach to the public; and (5) provisions for implementation of the management measures, policies, and programs including: (a) schedules with priorities for site mitigation and protection and other measures and provisions; (b) reporting to the Commission and other agencies; (c) composition of a Cultural Resources Advisory Group (CRAG); (d) a new Cultural Coordinator position within Puget; and (e) dispute resolution and conflict management. The CRAG members would serve as the point of contact for communication related to cultural resources among Puget, the agencies, and the tribes.

*Effects Analysis*

The HPMP is designed to manage the effects of project operations and environmental measures on historic properties in the project's APE. Recommendations of the completed archaeological and historic resource surveys are incorporated into the HPMP and provide the basis for site-specific measures as well as ongoing identification, evaluation, and protection activities during the term of any new license. A program of on-going monitoring of recorded archaeological and historic sites, historic districts, and other culturally sensitive areas, as detailed in the HPMP, would enable Puget to take protective actions when warranted by site-specific conditions. Table 3-35 summarizes the threats and management recommendations for prehistoric and historic archaeological resources considered eligible.

The HPMP sets forth a process for the CRAG and Puget staff to determine if project-related activities could affect a historic property, if additional identification efforts are required, and to identify measures necessary to avoid adverse effects on a historic property. A list of activities that would not need to be reviewed is appended to the HPMP. Implementation of the HPMP would minimize or avoid harm to historic properties within the project's APE.

The HPMP provides for ongoing consultation with the tribes and the incorporation of information on traditional cultural property identification efforts. Although no traditional cultural properties have been identified in the project's APE to date, the HPMP would address newly discovered or newly identified historic properties during the term of any new license. Further, the HPMP would provide the tribes with an archive and a framework within which to evaluate the effects of project -related activities on traditional cultural properties, should any be identified. Implementation of the HPMP, in conjunction with Tribal consultation, would minimize or avoid harm to properties of cultural or religious significance to the tribes.

***Secondary Effects of Proposed Measures***

Many proposed articles propose new or modified project facilities that would require ground-disturbing activities with the potential to affect archaeological resources. Some existing project facilities that would be modified are eligible or listed in the National Register. Significant changes that could affect historic properties are summarized below:

- Construction of a new auxiliary powerhouse immediately adjacent to the existing Lower Baker powerhouse;
- Planting vegetation, placing anchored logs, installing riprap, installing rock and crib walls to control shoreline erosion under Proposed Article 110;
- Installing new water systems at Spawning Beach 4 and decommissioning Spawning Beach 1 and Spawning Beach 2 under Proposed Article 101;
- Installing new and modifying existing upstream and downstream fish passage facilities under proposed articles 103, 104, and 105;
- Acquiring and enhancing wetland habitats under Proposed Article 504;
- Topping or modifying trees (that may be culturally significant) near Lake Shannon to provide osprey nesting sites under Proposed Article 506;
- Hardening and upgrading disperse recreation sites under Proposed Article 308;

- New recreation trails near the Lower Baker Development under Proposed Article 311; and
- Planting vegetation, painting, fencing and new visual elements pursuant to an aesthetics management plan under Proposed Article 302.

Other modifications could affect the characteristics for which facilities are considered eligible or listed in the National Register. Construction of the new auxiliary powerhouse and new visual elements introduced under the aesthetics management plan could affect the characteristics for which the Lower Baker Development is listed in the National Register. Decommissioning Spawning Beach 1 and Spawning Beach 2 and new/modified fish passage facilities could affect contributing elements of the Hydroelectric District. Increased recreation from new and improved recreation sites could affect potential traditional cultural properties or could attract visitors to project-related areas not surveyed for historic properties.

All project-related construction activities would be reviewed under the HPMP, which provides a process for identifying, evaluating and mitigating actions that could affect historic properties. This review process would ensure that the new auxiliary powerhouse, shoreline erosion control measures, new and modified fish passage facilities, environmental measures, and new elements introduced pursuant to an aesthetics management plan would avoid and minimize project effects on historic properties.

#### 3.3.7.3 Unavoidable Adverse Effects

Such effects as shoreline erosion may not be totally eliminated; however, adoption and implementation of a HPMP would provide for the phased documentation and stabilization of affected archeological sites. As a result, there may be the possibility of the loss of some cultural resource material and sites by shoreline erosion, but implementation of a HPMP would minimize or mitigate such effects.

#### 3.3.7.4 Cumulative Effects

The Baker River Project is one of several hydroelectric projects in the Northwest region of Washington State that affects prehistoric and historic archaeological resources located along its shorelines and in the drawdown zones. Within the Baker and Skagit River watersheds, the continued operation of the Baker River Project and the Seattle City Light's Skagit River Project No. 533, and the erosion of shorelines associated with these projects, contribute to a cumulative adverse effect on cultural resources through the reduction of the number of potential sites that could provide information about the traditions of Indian tribes associated with the watersheds.

Both projects attract recreational use around and near the reservoirs. The increased recreational use resulting from the availability of large lakes also has contributed to the inadvertent or intentional destruction of prehistoric and historic archaeological resources. Seattle City Light has implemented an HPMP that includes measures to manage historic properties. These measures include stabilization of known resources from the effects of erosion and protection of resources from recreational use. Under the Proposed Action, Puget's proposed HPMP for the Baker River Project would include similar measures to manage historic properties. While continued erosion and recreational use of the project area would be expected to affect prehistoric and historic archaeological resources, the measures currently being implemented at the Skagit River Project and on Mt. Baker-Snoqualmie National Forest lands, taken in combination with the measures proposed in Puget's Baker River Project HPMP, would cumulatively reduce adverse impacts on cultural resources.

Within the watersheds, the cultural resource surveys conducted as part of the relicensing process have identified hundreds of prehistoric and historic archaeological resources (*e.g.*, 51 sites at the Baker River Project and 144 sites at the Skagit River Project). Other surveys conducted by developers of proposed hydroelectric projects on tributaries and site-specific surveys on Mt. Baker-Snoqualmie National Forest lands have added to the number of identified sites in the Baker River watershed. These sites have the potential to contribute to public understanding of the tribes who occupied or traversed the watersheds. The prehistoric site assemblages provide data to help understand the prehistory of the tribes in non-coastal and riverine and upland settings in the Pacific Northwest (Miss *et al*., 2004). Measures included in Puget's proposed Baker River Project HPMP to complete site identification and evaluation of prehistoric and historic archaeological sites, as well as culturally sensitive areas, would contribute to a beneficial effect on cultural resources in the watershed.

### 3.3.8 Recreational Resources

#### 3.3.8.1 Affected Environment

The Baker River basin is accessible to more than 6.5 million people in northern Puget Sound and southern British Columbia via an approximate 2-hour drive (100 miles). The area is easily accessed by a system of county and Forest Service system roads. The mountainous terrain, project reservoirs, and water courses offer spring, summer, and fall recreational opportunities including developed and dispersed camping, fishing, picnicking, swimming, hiking, boating, mountaineering, environmental education and interpretation, and scenic driving. Winter activities, such as cross-country skiing and snowmobiling, occur near the project.

### Regional Recreational Setting

More than 50 percent of the land within the Baker River basin and most of the land surrounding Baker Lake is publicly owned. Public lands surrounding the project area include the 1.7 million-acre Mt. Baker-Snoqualmie National Forest to the north, east, and south of Baker Lake; North Cascades National Park to the east of Mt. Baker-Snoqualmie National Forest; and WDNR and other Washington State agency lands interspersed throughout the lower watershed near Lake Shannon. Special designations within the Mt. Baker-Snoqualmie National Forest include the Mt. Baker and Noisy-Diobsud Wilderness areas, Mt. Baker National Recreation Area and the Skagit Wild and Scenic River. The Mt. Baker Wilderness Area consists of more than 117,500 acres surrounding Mt. Baker. The Noisy-Diobsud Wilderness Area, southeast of the project area and adjacent to the North Cascades National Park, encompasses 14,133 acres. The Mt. Baker National Recreation Area consists of 8,473 acres on the south slope of Mt. Baker, within the Mt. Baker-Snoqualmie National Forest and adjacent to the Mt. Baker Wilderness. The Skagit Wild and Scenic River is upstream of Sedro-Woolley and includes 99 scenic designation river miles and 58.5 recreation designation river miles. Special designations within the North Cascades National Park include the Stephan T. Mather Wilderness Area and adjacent Ross Lake and Lake Chelan National Recreation Area. The Mather Wilderness, Ross Lake National Recreation Area, and the Lake Chelan National Recreation Area complex total more than 634,000 acres.

Mt. Baker-Snoqualmie National Forest, North Cascades National Park, WDFW, Washington State Parks and Recreation Commission, county parks, and private campgrounds provide developed recreational facilities near the Baker River Project. These sites provide access to the water via boat ramps and hiking and camping along the numerous lakes, streams, and rivers in the region. Eight boat ramps provide access to the Skagit River, six of which are maintained by WDFW and two by the Washington State Parks and Recreation Commission; there are also some areas used for launching boats which are not formally developed facilities. Vogler Lake boat launch (3 miles from the Town of Concrete) and Grandy Lake County Park (approximately 1 mile west of Vogler Lake) provide two additional boat ramps in the region.

Regional hiking opportunities include developed trails within the North Cascades National Park, Mt. Baker-Snoqualmie National Forest, and state and county parks. The North Cascades National Park maintains more than 386 miles of trails within the Stephan T. Mather Wilderness. The Mt. Baker-Snoqualmie National Forest maintains 22 developed trails covering more than 64 miles within the Baker River basin. Other hiking opportunities are available within nearby Rasar State Park (3.7 miles of trails) and Rockport State Park (5 miles of trails) and along the Skagit County-owned Cascade Trail. Rasar State Park is approximately 7 miles west of Concrete, while Rockport State Park is 6 miles east of Concrete. The Cascade Trail is a 23.5-mile-long gravel, maintained trail

on an abandoned railroad grade, which parallels Highway 20 from Sedro-Woolley to Concrete and offers hiking, biking, and equestrian uses.

Developed campsites in the region offer both forested and waterside opportunities and are provided by the North Cascades National Park, Mt. Baker-Snoqualmie National Forest, state parks, county parks, and private entities. The North Cascades National Park requires backpackers and climbers in the Park to camp only in designated sites in some areas with high visitation; other areas are managed as cross-country zones where visitors may choose their own campsite. The Mt. Baker-Snoqualmie National Forest maintains seven campgrounds in the Baker River basin, five of which are adjacent to Baker Lake and discussed below. The other two Forest Service campgrounds (Park Creek and Boulder Creek campgrounds) are within 0.5 mile and 1.5 miles of Baker Lake, respectively. Developed camping facilities are also available at Rasar State Park, Rockport State Park, Grandy Lake County Park, Howard Millar Steelhead County Park, and the privately owned Creekside Campground. These areas provide camping opportunities for tents, trailers, and recreational vehicles (RVs) with a range of facilities for user comfort, including some with showers and RV hookups. At Lake Tyee, there is a privately owned resort where lots are leased on a long-term basis. Access to these locations is generally provided by paved roads, and there are public boat launches, fishing access and day-use sites at some of these locations. Descriptions of these facilities are included in the Recreation Needs Analysis (Huckell/Weinman Associates, 2004a).

Dispersed camping on the Mt. Baker-Snoqualmie National Forest has increased over the last two decades. The Forest Service estimates more than 370 dispersed camping sites within the Baker Lake basin; there are more than 230 sites accessed by roads, 17 sites accessed by boat on the east side of Baker Lake, more than 80 sites accessed by trails and approximately 60 camps used by climbers on Mt. Baker and Mt. Shuksan (Forest Service, 2002a). Puget identified 213 dispersed sites near the project reservoirs; 203 sites were identified near Baker Lake and 10 sites were identified near Lake Shannon.

### Facilities and Opportunities At or Near the Project

The Baker River Project area offers many opportunities for recreation, including bank and boat fishing, swimming, lakeside trails, vistas, camping, and environmental education and interpretation. Developed recreational facilities at or near the project include boat launches, designated swimming areas, a scenic vista, trails, campgrounds, the Lower Baker Visitors Center and fish handling facility, a resort, and a lodge/retreat facility. Table 3-37 summarizes the developed facilities at or near the Baker River Project. Six boat launch facilities provide boating access to project waters**.** Puget manages two sites with boat launch facilities (Baker Lake Resort and West Pass dike) at

Baker Lake and one at Lake Shannon. At Kulshan Campground, Puget maintains a heated restroom that is available year-round for the public. Puget maintains a gravel-surfaced boat ramp and parking area at Lake Shannon and provides portable restrooms and trash dumpsters; however, there are no developed recreational facilities such as restrooms, tables or picnic sites at the boat launch to support day-use or overnight camping. The Forest Service manages three facilities with boat ramps near Baker Lake-Shannon Creek, Panorama Point, and Horseshoe Cove campgrounds. Additional water access is available at two designated swimming beaches at Baker Lake, at Horseshoe Cove Campground and the Baker Lake Resort. At each of these facilities, there are designated day-use sites and boat launches.

Table 3-37. Summary of developed recreational facilities at or near the Baker River Project. (Source: Puget, 2002b; adapted from Forest Service, 2002a)

| Facility Name | Operator | Type of Use | Number of Campsites/ Rooms | Additional Facilities |
|---|---|---|---|---|
| Panorama Point Campground | Forest Service | Overnight | 16 | 2 day-use sites, boat launch, vault toilets, potable water |
| Horseshoe Cove Campground | Forest Service | Overnight | 38 | 9 day-use sites, 3 group campsites, boat launch, swimming, vault and flush restrooms, potable water, small boat rentals |
| Shannon Creek Campground | Forest Service | Overnight | 20 | 2 day-use sites, vault restrooms, potable water, boat launch |
| Boulder Creek Campground | Forest Service | Overnight | 10 | 1 mile from Baker Lake, restrooms |
| Park Creek Campground | Forest Service | Overnight | 12 | 0.5 mile from Baker Lake, restrooms |
| Maple Grove Campground | Forest Service | Overnight | 5 | Hike or boat in only on east shore of Baker Lake |

| Facility Name | Operator | Type of Use | Number of Campsites/ Rooms | Additional Facilities |
|---|---|---|---|---|
| Bayview North and South Campground | Forest Service | Overnight | 2 | Reservation-only/2 group sites with vault restrooms |
| Shadow of Sentinels | Forest Service | Trailhead | N/A | Approximately 1 mile from Baker Lake, 0.5-mile accessible interpretative trail, restrooms, paved parking |
| Baker River Trailhead | Forest Service | Trailhead | N/A | Gravel-surfaced parking area and vault restrooms |
| Schreibers Meadow | Forest Service | Trailhead | N/A | Approximately 14 miles from Baker Lake, trail, camping and picnicking allowed |
| Kulshan Campground [a] | Puget | Overnight | 116 | 75 RV hookups (sewer and water only), restrooms, picnic area, informational exhibit |
| Baker Lake Resort | Puget | Overnight | 90 campsites/11 cabin units | Day-use site, boat launch, 57 RV hookups, 9 group sites, flush and vault restrooms, showers, store, swimming |
| Baker Lake Lodge | Puget | Overnight | 9 rooms in Lodge<br>3 rooms in Nooksack trailer | 1 cabin (Nooksack trailer), tennis, volleyball, basketball courts |
| Glover Mountain [a] | Puget | Day use | N/A | Overlook with fenced viewing area of Upper Baker dam, 0.3-mile-long trail, parking |

| Facility Name | Operator | Type of Use | Number of Campsites/ Rooms | Additional Facilities |
|---|---|---|---|---|
| West Pass dike [a] | Puget | Day use | N/A | 1 partially paved boat launch |
| Lower Baker Visitors Center and fish handling facility [a] | Puget | Day use | N/A | 0.2-acre paved parking area with restrooms, informational exhibits, and outdoor interpretive displays |
| Lake Shannon boat launch [a] | Puget | Day and overnight use | Approximately 30 | Boat launch and unpaved parking area used for dispersed day and overnight use |

Note:
N/A–Not available.
[a] Currently licensed project facilities. All other facilities are non-project facilities located within, partially within, or immediately adjacent to the current project boundary.

In addition to the boat ramps and beach access points associated with Baker Lake, Puget provides the Glover Mountain Overlook site with a view of Baker Lake, the Upper Baker dam, and the surrounding national forest. The site has a viewing area adjacent to a gravel parking lot and a 0.3-mile-long loop trail through the nearby forest. A second viewpoint near Baker Lake, known as Boulder Creek Viewpoint, is located on National Forest System land. This site is not a developed recreation facility, but rather it is a paved portion of the shoulder along the Baker Lake Highway that has space for visitors to park and enjoy views of Mt. Baker. Another site, Rainbow Falls Overlook, is located on Forest Service Road 1130 approximately four miles from the Baker Lake Highway.

In the downstream portion of the project near Lake Shannon, Puget operates the Lower Baker Visitors Center and Fish Handling Facility. This facility provides restrooms, interpretative displays, and a parking area just below the Lower Baker dam in the Town of Concrete.

The project reservoirs offer developed lakeside camping and swimming facilities. The Forest Service and Puget operate nine developed campgrounds that have 309 campsites at or near the project; six of these campgrounds—Shannon Creek, Panorama Point, Horseshoe Cove, Maple Point, Bayview (North and South) and Baker Lake Resort—offer lakeside campsites. Puget operates the Kulshan Campground, which is approximately 1,000 feet back from the Baker Lake shoreline, and the Forest Service

offers two campgrounds with forested camping: Park Creek Campground and Boulder Creek Campground.

Facilities at Kulshan Campground include 116 campsites with approximately 75 water and sewer RV hookups west of the south shore of Baker Lake near the Upper Baker dam. The Bayview North Campground, which is a reservation-only group campsite, evolved from a dispersed campsite; the Forest Service improved the site with vault restrooms and fire rings. Construction of the Bayview South Campground was postponed midway through construction; consequently, the facility was only partially completed. It was improved in 2001 and opened as a reservation-only/group site. The site has vault restrooms and loop roads with two defined group camping areas. The Forest Service Maple Grove Campground, located on the east shore of Baker Lake, is a non-fee site with five developed campsites and is only accessible via hiking or boating. The Baker Lake Resort, about 6 miles north of Upper Baker dam and operated by Puget under a special use authorization from the Forest Service, has 90 campsites. In addition to the camping opportunities, the Baker Lake Resort has 11 cabin units, a store, a swimming area, and mooring facilities.

There are also 10 dispersed sites in the vicinity of Lake Shannon and 203 dispersed sites near Baker Lake that were inventoried as part of the Dispersed Site Inventory Report (Huckell/Weinman Associates, 2004b). Most of the dispersed sites at Baker Lake are located on the shoreline or adjacent to tributaries near their terminus at Baker Lake.

The Puget-operated Baker Lake Lodge, located near the Upper Baker dam, offers a conference/retreat facility with a nine-room lodging facility and a separate cabin.

Recreation Resource Management manages all of the Forest Service campgrounds in the Baker River Project vicinity under a special use authorization, except for Maple Grove, which the Forest Service manages. This arrangement allows a third party to collect the fees associated with a government-owned facility in return for performing annual O&M of the facility. The concessionaire compensates the federal government for the use of the land and the facilities with a percentage of the revenue generated at the facility. A concessionaire may perform maintenance or replace components of a concessionaire-operated facility in lieu of payment of the fees payable to the federal government under terms of this arrangement. The existing special use authorization for managing these campgrounds terminates in 2007.

**Trails**

The Forest Service maintains the approximately 14-mile-long Baker Lake Trail along the east shore of Baker Lake and the 1.6-mile-long Baker River Trail, which

traverses land northward into the NPS' North Cascades National Park, as the only developed hiking trails near the project boundary. The trailhead for the Baker River Trail, which is located at the terminus of the Baker Lake Highway (FS Road 11), consists of a gravel-surfaced parking lot and a vault restroom. Nearby trails located upland from Baker Lake include the Mt. Baker-Snoqualmie National Forest Shadow of the Sentinels Trail and several trails accessed from the Schreibers Meadow Trailhead. About one mile of accessible trail is available on a portion or all of two trails, Baker River Trail and Shadow of the Sentinels Trail.

The Shadow of the Sentinels Trails was reconstructed as a mitigation and enhancement measure for the Koma Kulshan Project, a separate hydroelectric project with a powerhouse located on Sandy Creek in the Baker River basin. Koma Kulshan operates and maintains the trail. The Shadow of the Sentinels Trails is one of the few accessible trails located in an old-growth forest setting and it is designated as a National Recreation Trail. The trailhead consists of a vault restroom and a paved parking area that is plowed for winter recreation use.

The trails in the watershed provide hiking and equestrian use, some of which access designated wilderness areas, road-less (boat-in and hike-in) areas of the North Cascades National Park and Mt. Baker-Snoqualmie National Forest, National Recreation Areas, climbing routes for Mt. Baker and Mt. Shuksan, and glaciers. Trails within the Baker Lake watershed are shown in table 3-38. None of the trails are located within the project boundary.

Table 3-38. Summary of trails within the Baker River watershed. (Source: Forest Service, 2002a; adapted from Forest Service, 2001)

| Trail Name | Length of Trail (miles) | Designated Use | Estimated Average Annual Use[a] |
|---|---|---|---|
| Park Butte | 3.5 | Pack and saddle | 5,000 |
| Scott Paul | 6.5 | Hiker | 800 |
| Railroad Grade | 1.0 | Hiker | 1,600 |
| Blue Lake | .7 | Hiker | 2,000 |
| Dock Butte | 1.5 | Hiker | 1,000 |
| Boulder Ridge | 3.6 | Hiker | 2,200 |
| Baker River | 1.6 | Hiker (1 mile)/pack and saddle 0.6 mile) | 2,600 |
| Swift Creek | 8.0 | Hiker | 500 |
| Shuksan Lake | 2.0 | Hiker | 1,500 |

| Trail Name | Length of Trail (miles) | Designated Use | Estimated Average Annual Use[a] |
|---|---|---|---|
| Baker Lake | 14 | Pack and saddle | 2,300 |
| Noisy Creek | 1.0 | Hiker | 300 |
| Watson Lakes | 2.3 | Hiker | 3,000 |
| Anderson Butte | 1.5 | Hiker | 300 |
| Anderson Lakes | .4 | Hiker | 1,000 |
| Shadow of the Sentinels | .5 | Barrier free | 5,500 |

[a] Number of visitors

### Facility Condition and Accessibility

The Forest Service constructed campgrounds and day-use areas in the 1950s and 1960s at Baker Lake. Some modifications and repairs have been completed since their construction, but most of the facility components consist of the original structures, and the sites are in the original design. Shannon Creek Campground was constructed in 1973, and Horseshoe Cove Campground was modified in 1980. The existing Forest Service campgrounds have short spurs and narrow access road widths and turning radii that do not easily accommodate RVs and trailers.

The Forest Service recreational facilities do not provide barrier-free recreational use because they were constructed before accessibility for the disabled became a consideration. The restrooms that have been installed in the past few years at some of the facilities accommodate persons with disabilities. Accessible picnic tables have also been installed in some locations. However, there are numerous barriers in the routes of travel between campsite features and inside many of the restrooms. There are also deficiencies related to accessibility with the water faucets, trash bins, signage, fire grills, tables, and campsite spurs (Puget Sound Energy, 2005). There are no sites designated for persons with disabilities, and there are no accessible routes to access the shoreline of the project reservoirs.

The Baker Lake Lodge and the Lower Baker Visitors Center were modified to provide access for the disabled and these facilities are in good condition.

The recreational facilities that Puget owns at Kulshan Campground have been maintained since their construction and are in good condition. There are components, particularly restrooms that do not meet the needs of the disabled. There are no sites designated for persons with disabilities, and there are no accessible routes to access the shoreline. The recreational facilities that Puget owns at the Baker Lake Resort are worn;

however, Puget maintains them and regularly replaces items (such as fire pits). Portions of the dock, shower, restrooms, water system, septic system and electrical fixtures are not in good condition. There is minimal accessibility at this site for persons with disabilities.

The responses to recreation visitor surveys (Huckell/Weinman Associates, 2004) addressing facility standards taken in 2001 indicated a range of satisfaction levels. At Baker Lake, the types of recreation services/facilities that received comparatively large percentages of low satisfaction ratings included showers/restrooms, wheelchair access, potable water supplies, access roads, and the camp store. These concerns appear to be related to the absence of some of these facilities or services, or if the facility or service is provided, the visitors expressed dissatisfaction with its quality. Visitors to the Forest Service campgrounds also expressed dissatisfaction with the reservation system. The recreation visitor survey provides the details of the specific concerns raised by the visitors at each facility. Likewise, the ratings provided by the respondents indicate high satisfaction with campsite conditions, helpfulness of employees, and the ease of locating a site. At Lake Shannon, the visitors expressed dissatisfaction with the parking area, cleanliness, potable water, and the quality of the access road. In an earlier study (Tarrant, Erin Smith, and H. Ken Cordell, no date) conducted between 1990 and 1994, the authors find that visitor needs for information and clean facilities (particularly restrooms) are consistent with previous studies. Thus facility condition, barrier-free access, and maps, informational signs and bulletin boards continue to be important to visitors.

**Recreational Use Levels**

Recreational use within the Baker River watershed is seasonal, with the highest amount of use occurring during the summer. Visitation use figures indicate that more than 50 percent of all use occurs on weekends, with July and August receiving the highest number of users. Use during July and August weekends typically accounts for 30 to 40 percent of the annual use (Forest Service, 2002a). Huckell/Weinman Associates (2004) recreation visitor survey data for the project area in 2001 indicate that approximately 90 percent of the total of 789 survey respondents visit Baker Lake while the remaining 10 percent visit Lake Shannon. Nearly 66 percent of the people surveyed indicated they were staying overnight at Baker Lake and 24 percent were Baker Lake day users (Huckell/Weinman Associates, 2004c). Eight percent of all respondents were Lake Shannon overnight visitors, and the remaining 2 percent were Lake Shannon day users. The average party size of recreationists in the project area is 2.4 people (Huckell/Weinman Associates, 2004c).

According to the Forest Service (2005) recreation use on the Mt. Baker-Snoqualmie National Forest during the year 2000 was 5,006,932 visitors. Hiking or walking was listed as having a 21 percent participation rate, with 13 percent of the users reporting hiking or walking as their primary activity. Downhill skiing or snowboarding

was listed as having a 64 percent participation rate, with 60 percent of the users reporting downhill skiing or snowboarding as their primary activity. Thus, the Forest Service finds that 60 percent (3,004,159 visitors) of the 5,006,932 visitors during 2000 participated in downhill skiing or snowboarding.

The most popular activities at or near the project include camping, fishing (shore and boat), RV camping, and sightseeing. Twenty-two percent of the people surveyed indicated auto/tent camping in developed sites as their primary recreational activity (Huckell/Weinman Associates, 2004c). Forest Service campgrounds near Baker Lake average 125 days of operation during the recreational season (from mid-May through mid-September). Table 3-39 summarizes the estimated annual overnight use associated with the Baker River Project area.

Table 3-39. Estimated annual overnight use for the Baker River Project Area. (Source: adapted from Puget, 2002b)

| **Overnight Facility** | **Annual Visitors** |
|---|---|
| Forest Service developed facilities | 10,500 |
| Puget developed facilities | 18,076 |
| (16,168 at Kulshan Campground) | |
| (11,908 at Baker Lake Resort) | |
| Dispersed sites | 4,900 |
| **Total** | 33,476 |

The Forest Service estimates 6,000 people fish at Baker Lake and its tributaries each year, and 3,000 people boat and bank fish at Lake Shannon per year (Forest Service, 2002a). Among the Baker Lake survey respondents who indicated they fish, approximately 50 percent fish from shore, 40 percent fish from a boat, and 10 percent fish from both the shore and a boat (Huckell/Weinman Associates, 2004c).

Trail hiking is another recreational use in the project vicinity. Three difficulty classes for trails occur. Over half of the trails within the watershed are rated “moderate,” 34 percent are rated “easy,” and 15 percent are rated “difficult.” Over half of the trail use in the watershed occurs on the trails rated easy. Puget estimates that approximately 25 percent of visitors using the high country trails surrounding the project area are overnight visitors staying at Baker Lake (Huckell/Weinman Associates, 2004c).

The Forest Service classifies trails according to their use levels; low use is defined by 1 to 500 people; medium use as 501 to 2,500 people; heavy use as 2,501 to 5,000; and extra heavy use as over 5,000 people per year. As shown in table 5-65 estimated annual use for individual trails range from 300 to 5,500 people (Huckell/Weinman Associates, 2004).

The Forest Service expects regional population growth to generate increased demand for the existing recreational resources within the Baker River Project vicinity. Evidence of these expectations includes recreational site development history, visitor-use statistics, and an increase in the number of dispersed campsites. Since 1960, visitor use at Forest Service-developed campgrounds has increased by 50 percent, while capacity at Forest Service-developed facilities has only increased by approximately 33 percent (Forest Service, 2002a). The Forest Service also reports the number of dispersed campsites within the vicinity of the Baker River Project has increased by approximately 18 campsites per year and demand for such sites is expected to increase between 7 and 15 percent by 2010 (Forest Service, 2002a). Although this demand is expected to increase, much of the suitable land area at Baker Lake is already being used, potentially limiting additional use.

Washington State published estimates of future participation in outdoor recreation activities, which also indicate a growing trend for developed and dispersed recreation opportunities; however, between 2003 and 2013, this use is only expected to grow by 10 percent and 5 percent, respectively (State of Washington, 2003). Of the 14 categories of recreational activities studied by the state, those projected to have the greatest growth over the next 10 years are snowmobile use (42 percent), walking (23 percent), nature activities (23 percent), and cross-country skiing (23 percent). The report finds that all other activities will increase between 5 and 21 percent over the next 10 years, except for fishing and hunting/shooting, which are expected to decline by 5 and 15 percent, respectively. The Washington State Comprehensive Outdoor Recreation Plan (SCORP) (Interagency Committee for Outdoor Recreation, 2002) concludes that most of the statewide need appears to be at the local (near population centers) level, much of which is outside the traditional park setting. The SCORP provides estimates of the number of participants for activities in various settings; bicycling and walking are at the top of the list.

### Dispersed Recreation

Within the study area for the Dispersed Site Inventory Study Report (Huckell/Weinman Associates, 2004b), Puget identified 203 dispersed sites near Baker Lake and 10 near Lake Shannon that are estimated to have combined space to accommodate approximately 614 tents and between 2,000 to 3,000 people at one time. Seventy sites (33 percent) are accessed by roads; 70 sites (33 percent) are accessed by walk-in; 52 sites (24 percent) are accessed by a nearby trail; and 70 sites (33 percent) are accessed by boat. Some of the sites, including most of the sites on the east side of Baker Lake, have both trail and boat access, so the total exceeds 100 percent. Most (165) of the dispersed sites identified by Puget are located within 50 feet of the shoreline, usually one of the project reservoirs, with most of these sites occurring at Baker Lake. There are 45

dispersed sites located below the full pool reservoir shoreline or on the Baker River floodplain.

The types of resource effects at the dispersed recreation sites include vegetation damage, vegetation loss, erosion, runoff/sedimentation, human and animal waste, and litter. A description of the types and frequencies of occurrence of these conditions at the dispersed recreation sites is presented in the Dispersed Site Inventory Report Study (Study R12) (Huckell/Weinman Associates, 2004b).

The observed seasonal occupancy rates for dispersed sites at Baker Lake in 2001 were less than 20 percent and the sites at Lake Shannon were typically under 10 percent. It appears that a small number of the dispersed sites receive the majority of use through the recreational season. Consequently, most of the resource effects appear to occur at a small proportion of the dispersed sites.

**Public Safety**

A Whatcom County sheriff deputy, a full-time Forest Service law enforcement officer, and two to four seasonal Forest Service employees provide law enforcement for their jurisdictional lands; their patrols include Baker Lake. The Whatcom County deputy is currently responsible for the Whatcom County section of the Baker River basin and Mt. Baker-Snoqualmie National Forest land in the Nooksack drainage. The Forest Service law enforcement personnel generally respond to natural resource damage and enforce the forest regulations related to wilderness, campfire permits, and woodcutting; the Whatcom County Sheriff Department generally responds to other types of law enforcement situations. In Forest Service campgrounds under concessionaire operation and in Puget-operated campgrounds, campground hosts are responsible for enforcing campground rules, and if they need assistance, they contact either the Forest Service law enforcement officer or the Whatcom County sheriff deputy, as appropriate. The Skagit County sheriff and the Town of Concrete provide law enforcement at Lake Shannon. Officers issue an average of 710 citations per year within the basin. The majority of the citations are for violations of the forest permit programs related to the Northwest Forest Pass program[27] and woodcutting with an average of 460 citations per year (Forest Service, 2002a). Law enforcement data indicate that the second highest number of citations recorded within the basin is for disorderly conduct (Forest Service, 2002a).

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[27] A Northwest Forest Pass is required at trailheads in the Mt. Baker-Snoqualmie National Forest. Hikers can buy a $30 annual pass or a $5 day pass. Eighty percent of fees from the sale of Northwest Forest Passes are returned to the local national forests for maintaining facilities, providing services, or restoring ecosystems. See http://www.fs.fed.us/r6/mbs/recreation/activities/trails/index.shtml.

Communications within the Baker River Project area and surrounding areas are limited to radio and/or microwave-based telecommunication systems used by the Forest Service and Puget plant operators as well as Puget recreation staff. The steep terrain surrounding the project limits the use of cell phones at lower elevations, but cell phones can be used at higher elevations. No public, landline phones exist within the project area, but a telephone box is located at the main gate of Puget's Upper Baker compound. There are several signs posted in the Kulshan Campground directing the public to this location where emergency calls can be made.

### Project Operations

Operation of the Baker River Project involves a seasonal drawdown of the reservoirs to accommodate power generation and provide flood storage during winter and early spring. The reservoirs are held at near-full pool during the summer.[28] This operation directly affects the amount of exposed shoreline at Baker Lake and Lake Shannon and affects access to developed recreational facilities, such as boat ramps, beaches, and dispersed shoreline campsites. Visitor use is potentially affected in the spring, as the spring runoff and the filling of the reservoirs can occur after the start of fishing season in late April. Table 3-40 identifies the lake level elevations at and below which the six boat launches and two swimming beaches at the Baker River Project are unusable. Puget's West Pass dike launch is the only boat launch at Baker Lake that is available year-round. At Lake Shannon, the boat launch is usable year-round.

Table 3-40. The minimum lake level elevations at and below which the six boat launches and two swimming beaches at the Baker River Project are unusable.
(Source: Huckell/Weinman Associates, 2004a)

| Location | | Lake Elevation (feet msl) |
|---|---|---|
| **Boat Launch** | | |
| **Baker Lake** | | |
| | West Pass dike | 679 |
| | Horseshoe Cove | 711 |
| | Panorama Point | 715 |
| | Baker Lake Resort | 713 |
| | Shannon Creek | 719 |
| **Lake Shannon** | | |

[28] Full pool elevations for Baker Lake and Lake Shannon are 727.77 and 442.35 feet msl, respectively.

| Location | | Lake Elevation (feet msl) |
|---|---|---|
| | Shannon boat ramp | 381 |
| **Swimming Beach** | | |
| **Baker Lake** | | |
| | Horseshoe Cove | 719 |
| | Baker Lake Resort | 714 |

All of the boat launches at Baker Lake, except for West Pass dike, are located in one of the developed campgrounds at the project. The current operating seasons for these facilities, depending on weather and snow-melt, are as follows:

- Shannon Creek and Panorama Point—one week before Memorial Day through the weekend following Labor Day;
- Horseshoe Cove—second weekend in May through the third weekend in September; and
- Baker Lake Resort—first weekend in May through the first weekend in October.

At the lower lake elevations, additional dispersed campsites at Baker Lake are available because more beach area is exposed. However, the distances created at low reservoir elevations are likely to make some of the dispersed sites near the high-water mark unattractive to some users. Some sites are useable only when the reservoir is drawn down and some visitors seem to prefer camping on the drawdown-zone sites because they are closer to the water's edge.

#### 3.3.8.2 Environmental Effects

**Project Operations**

Reservoir levels can affect recreational activities, such as boating and swimming, at the project reservoirs. To safely launch boats, the level of the reservoir should be above the end of the boat launching lane. Also, reservoir levels at or near the high-water mark cover rocks and stumps at swimming beaches and maintain a suitable sandy shoreline for visitor use. The recreational season, when most swimming and boating occurs, occurs between Memorial Day and Labor Day. Currently, the project is operated to support recreational uses from July 4th to Labor Day weekend by maintaining the levels of Baker Lake and Lake Shannon at or above elevation 718.77 feet msl and elevation 404.75 feet msl, respectively.

As reservoir levels drop, stumps and rocks in shallow areas are exposed, potentially creating boating hazards. In addition, there are stumps that are at or near the reservoir surface near the shoreline even at full-pool. The distances that develop between some dispersed campsites and the shoreline when reservoir levels are lowered may cause some sites to be unattractive and decrease dispersed camping opportunities. The areas where reservoir depth causes concerns related to boating safety and dispersed camping opportunities include the elbow of Baker Lake, the west shoreline of Baker Lake, and the shoreline near the inlet of the Baker River.

Under the Proposed Action, Puget would operate the Baker River Project to achieve reservoir levels specified in Proposed Article 106 (Flow Implementation). For further discussion on Proposed Article 106 see section 2.0, Proposed Action and Alternatives.

**Boat Launches and Swimming Areas**—An analysis of reservoir water levels is based on modeling of project operations for 5 representative years using the HYDROPS model. See section 3.0, Environmental Analysis, for a discussion about the HYDROPS data used in the following analysis. The operational effects on reservoir levels on a monthly basis for different water-year types are discussed in the Water Quality section. For recreational uses, important points of reference are the elevations of the reservoir at which the six boat ramps and the swimming beaches become unusable. The Proposed Operations would not affect the percent of time that the West Pass dike and Lake Shannon boat launches are usable during the 5 representative water years, so we exclude these launches from our discussion below.

The effects of the reservoir elevations should be considered due to the availability of the developed campgrounds for public use. Our discussion about operational effects focuses on the months from May through September, which are the months of highest recreational use. Depending on weather, the months of April, October, and November may also be suitable for recreational use; therefore, we also include these shoulder season months in our analysis.[29]

Figure 3-20 shows a comparison of the percentage of time during each month, based on 5 representative water years that four of the six boat launches are usable.

[29] The campgrounds where all but one of the boat launch facilities are located are currently closed during these shoulder months.

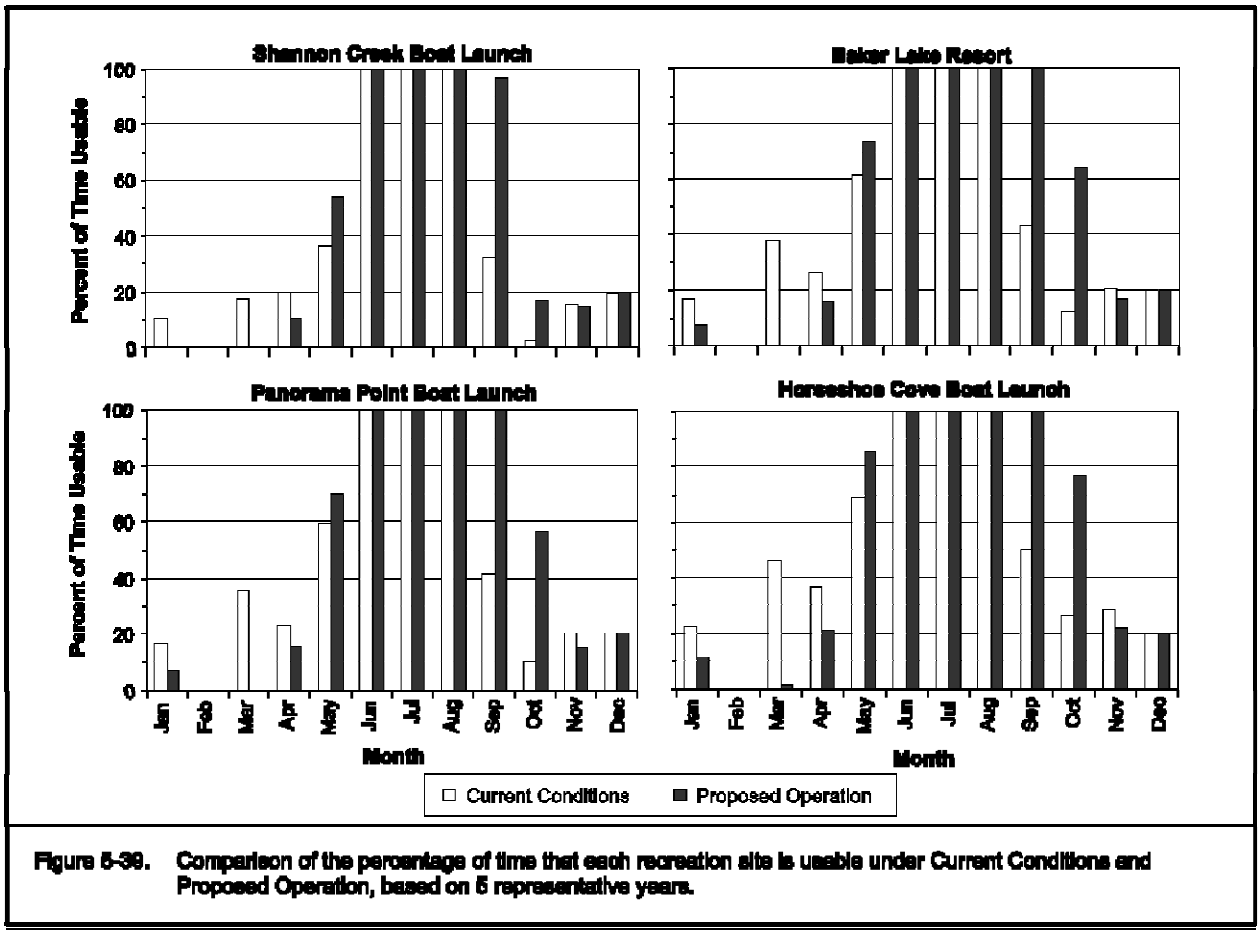


Figure 3-20. Comparison of the percent time during each month, based on five representative water years, that four of the six boat launches are usable, using the elevations presented in table 3-40.

During the peak recreational season (June through August) there would be no change in boat launch usability under the Proposed Operations as compared to Current Operations. All four of the boat launches would be usable 100 percent of the time under both the Proposed and Current Operations from June 1 to August 31.

During March, April, and May, each of these boat launches would be unusable for at least some portion of each month under both the Proposed and Current Operations. The effects during May would be more important considering that visitation begins to increase at this time. Under the Proposed Operations, there would be an increase of between 11 and 18 percent in the time when the boat launches at Shannon Creek, Panorama Point, Baker Lake Resort, and Horseshoe Cove would be usable as compared to Current Operations. During March and April, there would be less time when the boat launches would be available. However, as noted above, these months are outside of the

peak recreational season and the developed recreational facilities are not operated at this time; access is limited by Forest Service gate closures outside of the recreational season. Consequently, the effects of the Proposed Action on the boat launches during March and April would not adversely affect recreation.

Noticeable increases in usability of all of the boat launches would occur in September and October under the Proposed Action. In September under Current Operations, all of the boat launches would be usable 32 to 50 percent of the time; under the Proposed Action, the boat launches would be usable 96 to 100 percent of the time. Increased availability of boat launches in September resulting from the Proposed Operations could increase recreational opportunities at the reservoir beyond Labor Day, which would be outside of the recreation season in what is considered the shoulder season.

Under Current Operations, all of the boat launches would be usable 3 to 26 percent of time during October, while under the Proposed Action the boat launches would be usable 16 to 76 percent of the time. Given that October is outside of the recreational season, this effect would not be as important as the effects on the boat launches that occur between June and August.

Analysis of the modeled reservoir levels for different types of water years shows that, in general, the Proposed Action would cause the boat launches to become usable about the same time of the year (approximately the first week in May) in dry to average types of water years and 1 to 2 weeks earlier (approximately late April) in wetter water year types as compared to Current Operations. The effects of the Proposed Action are more pronounced in the fall when the reservoir elevations would remain high enough for the boat launches to be usable approximately 2 to 3 weeks longer (approximately October 1) than under Current Operations.

Other areas that could be affected by fluctuating reservoir levels are the swimming beaches. The swimming beach at Horseshoe Cove would become unsuitable at approximately the same reservoir elevation as the elevation that the Shannon Creek boat launch would become unusable, and the swimming beach at the Baker Lake Resort would become unsuitable at approximately the same elevation that the Baker Lake Resort boat launch would become unusable. From June to August, both swimming beaches would be usable 100 percent of the time under both the Proposed and Current Operations. As under Current Operations, the swimming beaches would be mostly affected during April, May, September, and October, when most people would not visit a beach to swim because air and water temperatures are generally cool. Also, the facilities at swimming beaches are rarely, if ever, open in April and October. Consequently, the Proposed

Operations would not adversely affect the usability of the Horseshoe Cove and Baker Lake Resort swimming beaches.

**Baker Lake Shoreline and Surface**—Under Current Operations, there are portions of the shoreline that become exposed along the north and western shores of Baker Lake. This effect is most pronounced outside of the period between Memorial Day and Labor Day. During the shoulder season, some dispersed campsites may become less desirable because of their distance to the shoreline, thereby reducing dispersed camping opportunities at the project in low-use periods. Exposed rocks and stumps at Baker Lake are also potential boating hazards as the reservoir level drops and this effect would also be most pronounced during the shoulder season. Floating debris that comes into the reservoir with snow-melt in the spring is also a concern for boating safety.

There is also a shallow portion of Baker Lake, which at the lowest reservoir levels, transforms from flat water to a flowing channel. At the lowest reservoir levels, boat passage between the upper and lower portions of Baker Lake can be restricted. Anecdotal accounts indicate that at reservoir elevations below about 693.8 feet msl, the water depth in this channel is only 1 to 2 feet, allowing only watercraft with a low draw and experienced operators to navigate the channel. At these lower elevations, the historic natural (pre-impoundment) Baker Lake is exposed, and this channel can provide access from the reservoir pool to the natural lake for smaller and more powerful boats. Also, even at extreme low pool, this channel is reasonably short and occurs in the drawdown to the east of the Baker Lake Resort. This reservoir elevation was analyzed to determine how frequently and when this condition would likely occur. Figure 3-21 shows a comparison of the percentage of time during each month that this area of Baker Lake would be navigable, assuming an elevation of 693.8 feet msl, based on 5 representative water years under the Current and Proposed Operations. It appears that navigation through the passage could be a concern during January and December. Because this effect would not occur during the months of the recreational season or even during the shoulder season months of May or September, this would not greatly affect access to the reservoir under Current or Proposed Operations.

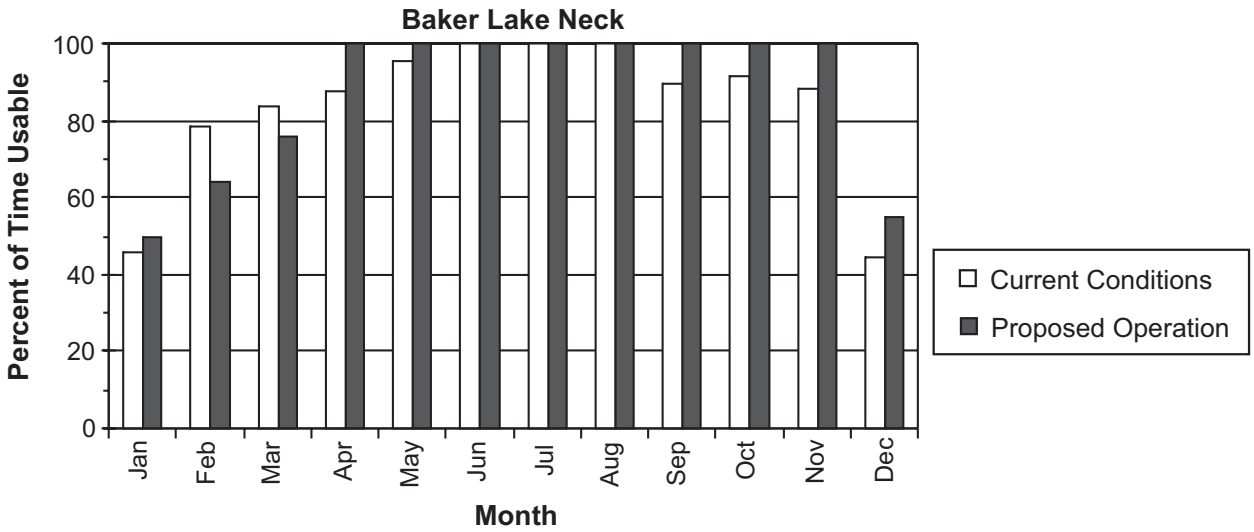


Figure 3-21. Comparison of the percent time that the narrow passage at Baker Lake is navigable under Current Conditions and Proposed Operations based on five representative years and a reservoir elevation of 693.77 feet msl.

Under the Proposed Operations, portions of the shoreline would be exposed as the reservoir level lowers, affecting the availability and suitability of dispersed recreation sites as well as revealing boating hazards. Compared to Current Operations, the reservoir level would generally be the same, at or near full pool, under the Proposed Action during June through August and it would be higher in May and September. Consequently, this would be an improvement during the shoulder season for dispersed recreation, resulting in a lower potential for boating hazards than would exist under Current Operations.

Furthermore, project operations have limited direct effect on the aesthetic/visual conditions of the recreation areas. Project features have no effect on the aesthetic/visual environment of these areas. The influence of project operations is limited to the areas adjacent to the reservoir and is dependent upon season and pool elevation (EDAW, Inc., 2004).

### Recreation

**Developed Recreation—**Baker Lake and Lake Shannon are project features that attract visitors to the area. These project reservoirs provide visitors with the opportunity for recreational activities, such as fishing, swimming, and boating. The land adjacent to the reservoirs provides overnight and day-use recreational activities, such as camping, picnicking, hiking, observing wildlife, hunting, shoreline fishing, and scenic driving. The demand for recreational experiences supported by developed recreational facilities at the project would continue and is expected to increase into the future. Continued operation of the project would help meet this demand through Puget's proposed measures at its recreational facilities. Based on recreation studies conducted during the relicensing

process, some of the existing facilities are probably not adequate to meet the future demand for public recreational use during peak season weekends.

Although Baker Lake and Lake Shannon are located fairly close to each other, there are two differences between them that cause different patterns of and opportunities for recreational use. Baker Lake is located almost entirely on National Forest System lands managed by the Mt. Baker-Snoqualmie National Forest, whereas Lake Shannon is located primarily on privately owned land. At Lake Shannon, Puget owns 10 percent of the land surrounding the impoundment, whereas the remaining 90 percent of the site and the access gravel road to the site are on land owned by Glacier Northwest, Inc. (Glacier). The second difference between the two impoundments is topography. The land around Baker Lake is gently sloping, but Lake Shannon is mainly surrounded by steep hillsides. Consequently, Baker Lake is more accessible because there are roads close to the shoreline that are open to the public and suitable sites to locate recreational facilities. This circumstance has resulted in development of public recreational facilities near Baker Lake, while Lake Shannon has public access constraints to the shoreline. The steep slopes and lack of public land near Lake Shannon restrict where recreational facilities can be sited; therefore, there is currently minimal recreational development.

**Bayview Campground**—The Bayview Campground was scheduled for construction in 1964, but construction was never completed due to lack of funds. The resulting sites known as Bayview North and Bayview South campgrounds were added to the Forest Service concessionaire program in 2001 with minimal improvements to provide additional group camping and site management until they could be redeveloped into single and group camping sites. Although the tables and fire rings have been replaced, wildlife-resistant trash receptacles have been installed, and a few additional spurs have been opened, Puget (2005) notes that the campground's restrooms, signs, spurs, roads, gates, and traffic barriers are in poor condition.

The Bayview Campground is available for overnight group use by reservation only. There is a $75 nightly fee for group camping (up to 25 people) at the Bayview North and Bayview South Campgrounds (http:www.fs.fed.us/r6/mbs/recreation/activities/campgrounds/bakerlake.shtml). Visitors to the campgrounds include groups of 1 to 6 people as well as those in a larger group. However, the facilities are not well known and receive occasional use. Consequently, the campgrounds' contribution to supplying overnight capacity is incidental compared to the other facilities at Baker Lake.

Under Proposed Article 309, Puget would provide funds to the Forest Service to rehabilitate and reconstruct the existing 28-unit Bayview Campground. Although the specific measures to rehabilitate the site are not identified in the Settlement Agreement,

Proposed Article 309, if implemented, would provide new infrastructure at the site (Puget Sound Energy, 2005).

*Effects Analysis*

Although specific measures to rehabilitate the site have not been identified, we note that Bayview South campground was rated as moderate to poor under the aesthetic/visual condition, due to site conditions or maintenance problems (primarily trash) and Bayview North campground was rated moderate to good (EDAW, Inc., 2004). Removing vegetation between the Bayview North and Bayview South campgrounds to Baker Lake would open up the areas and connect them visually to the lake. Clearing the over-story could provide more sunlight to the campgrounds, resulting in an open vegetative community (EDAW, Inc., 2004).

We discuss the cost of the Bayview Campground Rehabilitation and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

**Upper Baker Developed Recreation Maintenance Funding**—Horseshoe Cove, Shannon Creek, Panorama Point, Bayview, and Maple Grove are campgrounds near Baker Lake that provide lakeside camping opportunities. The Forest Service constructed the campgrounds between 1960 and 1973 and continues to operate and maintain these facilities. Since their construction, the only major development has been the addition of eight units to the Horseshoe Cove Campground in 1980.

Over the last decade, the Forest Service has seen a decrease of about 9 percent in its recreation budget at the same time that wages, associated benefits, and costs have increased. In the Mt. Baker-Snoqualmie National Forest, this situation created deferred maintenance and poorly functioning recreational facilities (Forest Service, 2002a). To resolve this issue, the Forest Service turned operation and maintenance of all five campgrounds over to Recreation Resource Management; however, this action did not alleviate the problem of deferred maintenance at the recreational facilities (Puget Sound Energy, 2005).

As previously discussed, the Recreation Visitor Survey Study (Study R13) (Huckell/Weinman Associates, 2004) indicates that the existing users displayed a range of satisfaction with recreation services and facilities available at the campgrounds. Despite the range of satisfaction levels, the survey also finds that of the 48 people responding to a preferred location for overnight camping, 29 percent of the respondents indicated Horseshoe Cove campground as a preferred choice and 15 percent indicated Panorama Point; an equal amount (10 percent of the respondents) indicated their

preferred choice was Baker Lake Resort and parks outside the river basin. Eight percent of the respondents indicated Shannon Creek as a preferred location.

Under proposed Article 313 (Upper Baker Developed Recreation Maintenance Funding), Puget would provide funds to the Forest Service for operation and maintenance at the following recreation facilities in the Upper Baker River basin: Shannon Creek; Panorama Point; Bayview; Horseshoe Cove; Maple Grove; and Baker Lake Resort. Proposed Article 313 also would require Puget to provide operation and maintenance for any future developed facilities that may be constructed as part of Proposed Articles 303, Baker Lake Resort Redevelopment Plan; 309, Bayview Campground Rehabilitation Funding; and 312, Developed Recreation Monitoring and Funding.

*Effects Analysis*

Baker Lake Resort and the campgrounds at Horseshoe Cove, Shannon Creek, Panorama Point, Maple Grove and Bayview North and South are located near Baker Lake and are non-project sites developed by the Forest Service to utilize the recreational opportunities created by Baker Lake.

Overnight use of the Forest Service developed campgrounds in 2001 was approximately 10 percent below the average for 1996-2001. When Puget began operating Baker Lake Resort in 1999, recreational use patterns showed an estimated 5 percent above the average for the first three seasons; resort use in 2001 was approximately 5 percent lower than reported for the 2000 season (Huckell/Weinman Associates, 2004).

Puget (2005) states that under Proposed Article 313, the visitor's experience at the campgrounds would likely improve due to increased patrols by the Forest Service at the sites resulting from the additional funding. Improved visitor's experience would likely increase recreation use at the sites. We note, however, that specific measures for the proposed article are not defined.

We discuss the cost of the Upper Baker Developed Recreation Maintenance Funding and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

**Lower Baker Developed Recreation**— Current public access to Lake Shannon is across private land, and there are minimal recreational facilities and services available to the public at this reservoir. The Lake Shannon boat launch has no formally developed facilities. However, Puget provides portable restrooms and dumpsters at the site. Most of the site is an open, dirt-surfaced area with minimal shade where visitors park RVs to camp. Some users at this site also camp in tents, primarily on a grassy peninsula located

to the south of the boat ramp where there are trees. The boat launch site is also close enough to the population center of the Town of Concrete and other nearby communities to make it convenient for day use as well as overnight use, and much of the use is from local residents. Puget reports that there are instances of people staying for extended periods, being inconsiderate of other visitors, and causing adverse effects on environmental resources. Currently, Puget enforces a 14-day limit, within 30 consecutive days, for visitors at the site. Some visitors expressed low satisfaction with the access roads, availability of potable water, cleanliness of the area, facility maintenance, and the quality of the parking area.

Under Proposed Article 305, Puget would prepare a Lower Baker Developed Recreation Plan, including acquisition of land for a Lake Shannon access site. A plan provision could be identifying an access area suitable for the construction of a concrete boat launch, parking area, and day-use area with an existing access road However, if suitable and cost-effective access on Lake Shannon is not acquired within 10 years of license issuance, Puget proposes, in consultation with the appropriate parties, to identify and acquire a suitable and cost-effective access site at an alternative location away from the project that would provide similar public recreational opportunities. Within 5 years of site acquisition of the alternative access site, Puget proposes to develop a small access site at the location.

Proposed Article 305 would also provide that if the eventual property for the boat access is acquired in a manner that would allow site development to exceed small boat access site standards, or if a party other than Puget develops recreational facilities in addition to those required by the proposed article, Puget would not be required to fund maintenance above what would be required for a small boat access site.

*Effects Analysis*

As previously discussed, Lake Shannon provides recreational opportunities on the reservoir and the immediate surrounding areas, although most access is across private land and can be constrained by topographical and geologic features.

Since the Settlement Agreement and Proposed Articles were filed November 30, 2004, an agreement between Puget and Skagit County to continue to operate the Lake Shannon boat ramp was reached. In a May 10, 2005 filing, Puget notes that Skagit County proposes, under a separate agreement with Glacier, to maintain the road and provide flaggers to aid with the safety of vehicles using the road for public access. The agreement between Glacier and Skagit County affords the opportunity to provide public access to the existing Lake Shannon boat ramp. Given that the Lake Shannon boat ramp is a project-related facility, a Lower Baker Developed Recreation Plan could provide for continued maintenance of the site.

Pursuant to Proposed Article 401 (Water Quality), Puget would develop and implement a water quality protection plan for all in-water or near-water construction work related to the project that could impact surface -or ground-water quality. This plan would take into account portable toilets, boat ramps, and access roads. Therefore, the Lower Baker Developed Recreation Plan would best be developed in concert with Proposed Article 401. We discuss the cost of the Lower Baker Recreation Plan in section 5.1, Comprehensive Development and Recommended Alternative.

**Baker Lake Resort Redevelopment Plan**—The Baker Lake Resort is a recreational development located on National Forest System land approximately 6 miles north of Upper Baker dam. This site was privately operated as a commercial resort under a special use permit from the Forest Service. In 1998, Puget acquired a Forest Service special use permit to operate the resort, which includes a family campground, group campground, cabins, playground, boat launch, store, and marina with boat rentals. The resort is not a project facility and the site is not within the project boundary.

Currently, the cabins are the only accommodations of the resort that could be considered heavily used or overused. Occupancy rates are greater than 70 percent in July and August. The RV campsites have occupancy rates of about 50 percent in July and August while the standard family campsites appear to be at or below 40 percent. The capacity of the campground at the resort (90 campsites) is approximately equivalent to the entire capacity of the campgrounds owned and operated by the Forest Service at Baker Lake. Overall, the resort has additional capacity to accommodate substantially more use during the peak season of July and August (Puget Sound Energy, 2005).

The resort has aged and worn components that have a high annual operation and maintenance cost. Puget states that it has operated the facility at a loss since it acquired the special use permit in 1998 (Huckell/Weinman Associates, 2004a). Puget does not intend to operate the resort beyond the expiration of the current special use permit in 2008.

Instead of continuing to operate the site as a resort, Puget, under Proposed Article 303, would prepare a Baker Lake Resort Redevelopment Plan to convert the resort to a campground with between 30 and 50 sites. Further, Puget would provide funds to the Forest Service for implementing the plan. The Forest Service would operate and maintain the site with funding from Puget.

*Effects Analysis*

Baker Lake Resort's location is a desirable setting for a campground near Baker Lake. But, due to the short water-related peak recreation season in western Washington,

the facility is not a viable business under its current operation as a resort. Redeveloping the site pursuant to Proposed Article 303, including decommissioning of the existing site and development of between 30 and 50 campsites, could enhance overnight recreation activities while addressing seasonal lakefront campground demand.

Rehabilitation of the Baker Lake Resort could improve the aesthetic quality of the area because existing substandard conditions at the site would be eliminated when the rundown buildings are removed. Removal of the buildings could also serve to reduce operation and maintenance costs of the resort incurred by Puget.

Although the specific measures to rehabilitate Baker Lake Resort are not defined, a change in the services and facilities provided at the site could be expected to make the site more economical to operate while still providing public recreation.

Huckell/Weinman Associates (2004) note approximately half of all local recreation sites, boat launches, and camp sites are located within the project study area.[30] According to the study, projected occupancy rates for Baker Lake Resort indicate the current supply of RV and campsites is sufficient to accommodate the expected demand over the next 20 years. The study concludes that for at least the next 10 years, the campsites at the resort represent surplus camping capacity in the Baker Lake area. We note that this surplus camping capacity may be the reason that the Forest Service proposes to decrease the existing 90 campsites at the resort to a range of 30 to 50 campsites under Proposed Article 303. Although the study indicates the existing 11 cabins are heavily utilized during the peak recreation season (July and August) these cabins would be removed under Proposed Article 303.

Study results (Huckell/Weinman Associates, 2004) indicate that while future capacity shortfalls are expected among the existing Forest Service facilities, the facilities that are currently operated by Puget could be available to accommodate future demand.

We discuss the cost of the Baker Lake Resort Redevelopment Plan and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

**Developed Recreation Monitoring and Funding**

Under Proposed Article 312, Puget would prepare a Developed Recreation Monitoring and Funding Plan. This plan would provide for monitoring site use and

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[30] The project study area is defined as all lands within the project boundary and adjacent lands within an approximate 0.5-mile radius.

occupancy levels at the Forest Service's Horseshoe Cove, Panorama Point, Bayview, and Shannon Creek campgrounds and at Puget's Baker Lake Resort, which would be redeveloped under Proposed Article 303. Data from the monitoring would be provided to the Forest Service annually. Monitoring results would be evaluated no later than 8 years after license issuance to determine if additional capacity should be developed. Puget proposes that the criteria for determining whether additional recreation site development at Baker Lake is necessary should be when monitoring reports document that the average combined site occupancy for Horseshoe Cove, Panorama Point, Bayview, Shannon Creek campgrounds and the Baker Lake Resort is at or exceeds 60 percent during July and August for 2 consecutive years (Proposed Article 312). Then, Puget proposes to provide funds to the Forest Service for developing the additional capacity, as specified in Puget's proposed Recreation Implementation Schedule.

*Effects Analysis*

The monitoring proposed in Article 312 could provide useful estimates of total recreational use and assessments of recreational issues at the Forest Service campgrounds and at Baker Lake Resort.

Due to the potential for increased recreation demand at the project and due to the proximity of the project to nearby population centers, we find that monitoring recreation use would allow Puget to determine the adequacy of public access and recreation facilities to meet recreational needs. This information would complement the recreational use information collected at 6-year intervals for the FERC Form 80-Recreation Report, section 8.11 of the Commission's regulations. Information collected could be shared with the Forest Service.

We discuss the cost of the Developed Recreation Monitoring and Funding and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

**Dispersed Recreation**

In addition to the developed recreational sites, there are areas with no formal, developed facilities located near the reservoir shorelines for camping or picnicking. In some areas, there are informal pit toilets, fire rings and picnic tables that have been created by users. The dispersed sites are created by users in areas where the Forest Service allows this type of activity. The locations and patterns of use at some of these areas cause concern for water quality, cultural resources, erosion, and vegetation impacts. Types of resource impacts identified in the Dispersed Site Inventory Study (Study R12) (Huckell/Weinman Associates, 2004) include erosion, hatchet marks and nails in trees, and trampled vegetation. Improper disposal of human and animal waste in the area surrounding dispersed-use sites occurs because suitable restrooms and bags for animal

waste are not provided. Litter is also a problem at these sites because there is no refuse service provided. User-created fire rings that are not properly located or constructed may pose a risk of wildfires.

The demand for dispersed recreational opportunities is projected to slightly increase over the next 20 years. Continued operation of the project would help meet this demand by supplying opportunities for lakefront camping and day use. Baker Lake provides the majority of opportunities for dispersed recreation use at the project because it is located primarily on public land managed by the Mt. Baker-Snoqualmie National Forest. Dispersed recreation use at Lake Shannon is limited by steep topography and private land.

**Dispersed Recreation Management Funding**

The reservoir shoreline attracts recurrent recreational use that, in some cases, adversely affects environmental resources. At Baker Lake there is a need to manage dispersed camping to protect water quality and environmental resources, thereby protecting the health and safety of the visitors to the project area.

Under Proposed Article 308, Puget would provide funds to the Forest Service for the preparation and implementation of a Dispersed Recreation Management Plan. Although no specific measures are identified, Article 308 suggests that the Dispersed Recreation Management Plan could describe management actions, operation and maintenance, monitoring objectives, and design plans for hardening[31] actions at three to six high-priority, dispersed recreation sites. Proposed Article 308 also suggests that the site-specific actions to be taken and the three to six dispersed sites selected for these actions could be identified in the plan. Because the sites are located primarily on public land and are currently managed by the Forest Service, Puget proposes to provide funds to the Mt. Baker-Snoqualmie National Forest for the plan and its implementation.

*Effects Analysis*

According to the SCORP (Interagency Committee of Outdoor Recreation, 2002), Washington State recommends the management of dispersed shoreline camping, consideration of eliminating dispersed camping, and relocating campgrounds where they have more visibility to discourage illegal uses.

Dispersed camping along the reservoir and in the surrounding areas is currently available on lands where the Forest Service permits this practice. Current recreational

[31] The term "hardening" refers to actions such as providing sanitary facilities, installing fire rings, controlling vehicle access with barriers, providing trash receptacles, installing bear boxes and formalizing paths of travel to sites.

use at some of the dispersed sites has resulted in undesirable health, safety and aesthetic conditions for the public as well as adverse effects on environmental resources. Hardening of certain affected sites, such as could occur through development and implementation of a dispersed recreation management plan, could improve the quality of recreational experiences associated with these sites and protect the visitors and environmental resources.

From the Dispersed Site Inventory Study (Huckell/Weinman Associates, 2004b) and information from Mt. Baker-Snoqualmie National Forest staff, Puget and the stakeholders agreed that there are areas where the effects of dispersed recreation use may not be acceptable. If Proposed Article 308 is implemented, visitors could either be more or less satisfied with their visit, depending on the level of development they seek for recreation. Study results indicate that only a few sites get more use than others and are used consistently throughout the late spring, summer, and early fall. Many of the sites inventoried may have been used once or a few times per season during peak season weekends when other sites were occupied. Consequently, this intermittent use does not pose the same health and environmental concerns that occur at sites with heavier use. Although the sites to be included in the dispersed recreation management plan would be identified in the future, Proposed Article 308 would appear to reflect the level of need identified by the study.

Development and implementation of a plan could formalize dispersed recreation sites by designating sites in suitable locations and therefore, be consistent with the SCORP.

We discuss the cost of the Dispersed Recreation Management Plan in the context of the sites relative to the Baker River Project boundary and our recommendation in section 5.1, Comprehensive Alternative and Recommended Alternative.

**Trails and Trailheads**

Visitors to the Baker Lake and Lake Shannon area participate in a variety of activities. Numerous trails and secondary roads provide access to dispersed recreation activities, such as camping, picnicking, hiking, backpacking, fishing, and winter sports (Huckell/Weinman Associates, 2004). Some hikers venture beyond Baker Lake and use trails leading into the adjacent wilderness areas and the North Cascades National Park. There are approximately 64 miles of trails within the Baker River watershed, of which approximately 17 miles are located in the lower elevations of the watershed near the project.

The Mt. Baker-Snoqualmie National Forestland resource and management plan and Whatcom County Plan recognize projected growth in the most popular activities of

walking and hiking and place a priority on providing additional trails to accommodate this use. The SCORP recognizes growth in recreation, which at times can lead to conflicts with other resource interests, including fish and wildlife. Data contained in the SCORP shows a large inventory of recreational trails; however, most trails are not located where they are needed the most (in or near town). Currently, the developed campgrounds at Baker Lake do not have trails that provide connections to other areas of recreational activity; visitors must currently drive, bike, or walk on roads. The Town of Concrete has no trail connections to the project or nearby natural resource features. In a Recreation Capacity and Suitability Analysis (Study R11) and Recreational Trail Analysis (Study R15) (Huckell/Weinman Associates, 2004), the studies examined desired connections and potential locations for trails within the existing Baker River Project boundary and adjacent lands within a range of approximately 0.5 mile.

**Upper Baker Trail and Trailheads**—Existing trail systems associated with developed sites at Baker Lake provide a limited range of opportunities for trail-based recreation. Although there are currently hiking trails in the vicinity of Baker Lake, most of these existing trails are routes that lead to destinations in the Mt. Baker Wilderness, North Cascades National Park, and the Noisy-Diobsud Wilderness rather than to recreational destinations in and around Baker Lake. Opportunities for overnight visitors to walk or hike on trails connected to the developed recreational facilities are limited.

Puget and the stakeholders determined that creating new trails would respond to the need for additional trails in the project vicinity and could be consistent with the priorities and recommendations identified by the Mt. Baker-Snoqualmie National Forest land and resource management plan, SCORP, and county plans. The Mt. Baker-Snoqualmie National Forest land and resource management plan (Forest Service, 1990) notes that reconstruction of existing trails within wilderness is a higher priority than new construction. The plan states that trails would be reconstructed to protect wilderness from further adverse effects on environmental resources. For non-wilderness trails, the plan states that 134 miles of new trail would provide alternative recreation opportunities.

Under Proposed Article 310 Puget would provide funds to the Forest Service for up to 6 miles of new multi-season, multi-use, non-motorized Forest Service trails.

*Effects Analysis*

The addition of non-motorized multi-use trails could contribute to a cumulative beneficial effect on the existing trail system within the river basin. The proposed new trails, under Proposed Article 310 and Proposed Article 314, would increase the number and length of trails available for the public, and provide visitors to the project with improved access to other locations and facilities in the Baker Lake vicinity. The

proposed 6 miles of new trails in the Baker Lake (Upper Baker) area could provide new hiking opportunities at existing recreation sites.

Under proposed Article 314, Puget would provide funds to the Forest Service for a percentage of the total annual funding necessary to operate, maintain, and replace facilities associated with the Baker River Trail, Baker Lake Trail, and Baker Lake North and South trailheads. Both trails and both trailheads are located outside the Baker River Project boundary.

We discuss the costs of the Upper Baker Trail and Trailheads and our recommendations in section 5.1, Comprehensive Development and Recommended Alternative.

**Lower Baker Trail Construction and Maintenance**—Under Proposed Article 311, Puget would develop a Lower Baker Trail Construction Plan in consultation with appropriate parties. This plan would include site selection, development criteria and construction of up to 2 miles of trail in the vicinity of the Town of Concrete. Under proposed Article 315, Puget would maintain the Lower Baker Trail at an estimated annual cost of $620.

*Effects Analysis*

In the vicinity of the Town of Concrete where one trail terminates, new trails would expand the opportunity for visitors at this area associated with the project and respond to the need for trails to support walking and hiking opportunities in and near communities. Lake Shannon is a project feature that attracts visitors to the project area. Other project features in the lower Baker River Project vicinity, including fish handling facilities and the Lower Baker dam, are also public attractions. Construction of a multi-use trail in this area would contribute to a beneficial effect on recreation resources in the vicinity of the Lower Baker Development.

Puget's proposed measure to develop and implement the Lake Shannon Boat Launch under Proposed Article 305 would compliment the proposed multi-use trail by offering continued public access and improved recreation facilities. Overall, Proposed Article 311 and its associated Proposed Article 315 would enhance the recreation resources at Lake Shannon.

We discuss the cost of the Lower Baker Trail Plan and our recommendation in section 5.1, Comprehensive Alternative and Recommended Alternative.

**Forest Service Roads and Access**

Public access to the reservoirs is currently by way of roads across public land under the jurisdiction of the Forest Service, and Skagit and Whatcom Counties, as well as land owned by Puget. The public also crosses privately owned land, where a public right-of-way may or may not exist, to access the reservoirs. Because public access for recreation may require year-round motorized access, managing access for the project operations and natural resource management may require restricting the location, type, and timing of permitted access.

Under proposed Article 316, Puget would provide funds to the Forest Service for annual maintenance of up to 25 miles of existing Forest Service roads in the river basin. The Forest Service roads include FR 11 (Baker Lake Highway); FR 1106 (Depression Lake); FR 1107 (Anderson Road); FR 1118 (Horseshoe Cove and Bayview); FR 1122 (Lower Sandy Creek); FR 1136 (Lower Boulder Creek); FR 1137 (Panorama Point); FR 1142 (Baker Lake Resort); FR 1150 (Shannon Creek campground); and FR 1168 (Baker River Trailhead North). The funding is intended to be used by the Forest Service, in part, to pave the approximately 1-mile-long Forest Road 1106 during the sixth year following license issuance and for periodic resurfacing.

Under proposed Article 317, Puget would continue to provide public road access to the east side of Baker Lake on Forest Road 1106 except as may be restricted for short-term public safety or project security reasons.

*Effects Analysis*

The continued presence of Baker Lake is a destination for recreationists. This presents a need to provide access for land and water-based activities at recreation facilities for current and potential recreational users.

The funds to the Forest Service provided under Proposed Article 316 would include fund for paving FR 1106 and could supplement the maintenance funding used by the Forest Service with jurisdiction for other roads. The public would likely see fewer potholes and rough surfaces on roads in the project vicinity, which could improve user satisfaction. Better roads could lead to increased use at the recreational facilities.

We note FR 1106 provides public access to the east side of Baker Lake across Upper Baker dam. Public access to the east side of Baker Lake has been available across Upper Baker dam since its construction. Proposed Article 317 would continue to provide this access and provisions for restricting the access for public safety and project security, as needed.

Puget (2005) states that the Forest Service proposes to permanently or seasonally close many spur roads off FR 11 (Baker Lake Highway) near the northwest end of Baker Lake to protect wildlife (elk, mountain goat, grizzly bear, or the bald eagle) or to convert road segments to recreation trails. English and Home (1996) note that road closures benefit people who participate in trail use, camping, day use, and snowmobiling. Road construction benefits people who participate in motor viewing and fishing.

While Proposed Article 316 identifies Forest Service roads in the project vicinity, we can not determine how the roads, except for FR 1106, are influenced by project-related operations. Although Proposed Article 316 could complement the Forest Service desire for an improved level of maintenance at the roads, we find the majority of the roads are utilized for multi-use that lead to non-project facilities.

We discuss the cost of the Forest Service Road Maintenance Funding and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

**Recreational Safety**

The project reservoirs provide visitors with the opportunity to enjoy recreational activities, such as fishing, swimming, and boating. The land adjacent to the reservoirs hosts overnight and day-use activities such as camping, picnicking, hiking, observing wildlife, hunting, shoreline fishing, and scenic driving. While participating in these activities at the project, visitors may be involved in accidents or face unplanned events that could create a danger to them.

**Recreation Water Safety Plan**— Under Proposed Article 304, Puget would develop the Baker Reservoir recreation water safety plan. The plan would require Puget to (1) provide funds to the Forest Service for constructing and installing 8 to 12 bulletin boards at locations to be determined, (2) provide displays and tear-sheet maps for visitors with information about reservoir safety and provide these at specified locations, and (3) construct and install floating log booms or suitable structures to separate existing designated swimming areas from boat traffic on the reservoir at Horseshoe Cove and Baker Lake Resort. Proposed Article 304 would also require Puget to maintain the log booms, provide safety signage at swimming areas and monitor hazards that may affect reservoir recreation. In addition, Puget would provide funds to the Forest Service to contribute to its efforts in carrying out the purposes of the proposed article.

*Effects Analysis*

As required under the Commission's regulations, Puget has developed and implements a public safety plan for the Baker River Project; therefore, there is no need for a separate recreation water safety plan. Any public safety measures that Puget would

propose to install on project lands and waters would require Puget to consult with the Commission and modify its existing public safety plan accordingly.

For further discussion see section 2.1.2.5, Project Safety. We discuss the cost of the Baker Reservoir Recreation Water Safety Plan and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

**Law Enforcement**—The presence of people and projected increased visitation near the project create a need to provide for public assistance. The types of situations that currently or potentially exist include theft, vandalism, wild fire, search and rescue, and boating and vehicle accidents. Puget (2004) notes that the northern reaches of the Baker River basin that lie within Whatcom County are physically isolated from the county, making it difficult for the sheriff's department to maintain a continuous presence in the area and to offer an adequate response time to incidents without stationing an officer in the area.

Although counties and agencies managing the public land surrounding the project have jurisdiction and funds to provide law enforcement, these entities comment that additional funds are needed from Puget to adequately provide law enforcement attributed to visitors using the project reservoirs.

Puget (2004) notes that it currently pays taxes to three jurisdictions (Whatcom and Skagit Counties and the Town of Concrete) in which a portion of the taxes paid are intended to support public services, including law enforcement. Puget also provides and maintains housing for a Whatcom County local deputy at the project. The Forest Service provides funds to Whatcom County to patrol National Forest System lands in the county. The Forest Service also employs one full-time law enforcement officer and two to four seasonal employees who patrol National Forest System lands.

Under Proposed Article 318 Puget would facilitate the development of a Law Enforcement Plan (LEP) with various agencies that provide law enforcement in the project vicinity and the river basin. The LEP may include provisions for law enforcement presence, other types of public contact personnel presence, enhanced emergency communication and response procedures, public safety and security, protection measures for facilities, natural resources, recreation resources, and cultural resources. Under Proposed Article 318, Puget would provide funds for the development and implementation of the LEP.

*Effects Analysis*

We discuss the cost of the LEP and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

### Public Information, Interpretation, and Education

During the relicensing process, Puget and the stakeholders identified the need to improve visitor information, interpretation, and education at the project. The recreation needs analysis (Huckell/Weinman Associates, 2004) identified a need for more information, education, and interpretation, including information signs, at the Baker River Project. In support of its finding, we note various federal, state and county agencies' plans recognize a projected growth in public participation and interest in interpretive programs.

Visitors can obtain information about programs and facilities at the Forest Service office in Sedro-Woolley, at the Lower Baker Visitors Center, and from information boards at campgrounds, day-use areas, and boat launches. Rules and regulations are also often included on these display boards. Interpretive programs are not generally available at Baker Lake; however, the Shadow of the Sentinels Trail is used by visitors and a salmon related interpretive program has been provided at the Baker Lake Resort. During the recreation season, Puget provides interpretive and education programs at the Lower Baker Visitors Center. Puget also provides tours of the fish handling facilities for organized groups such as schools.

As discussed below, Puget would address visitor information under Proposed Articles 306 and 307. Because these two proposed articles are interrelated, we have combined our discussion.

**Upper Baker Visitor Information and Interpretive Services Funding**—Under Proposed Article 306 Puget would provide funds to the Forest Service for visitor information services in the Baker River basin. The funds would be used for (1) planning, designing, and constructing a small Upper Baker Visitor Information Station (VIS); with parking, information kiosks, and sanitation facilities; (2) staffing and operations from Memorial Day through Labor Day at Baker Lake; and (3) supporting the summer recreation season from Memorial Day to Labor Day for the Mt. Baker Ranger Station in Sedro-Woolley.

Under Proposed Article 307, Puget would provide funds to the Forest Service to (1) prepare an interpretation and education plan; and (2) plan, staff, and produce materials to provide interpretive services. Themes that may be included in the interpretation and education plan are: (a) local culture and history; (b) aquatic, terrestrial and other natural resources; and (c) stewardship and project features.

*Effects Analysis*

Interpretation of environmental and cultural resources, including project facilities and the importance of hydroelectric power, would fulfill a need identified during the relicensing process. We note, however, that the proposed HPMP for the project takes into account the interpretive element of cultural resources; therefore, we do not find a need to address cultural resources separate and apart from the HPMP. Rather, this element better coordinates with an interpretation and education plan for the Baker River Project, as discussed below.

Providing the public with information about the project in relation to the environment and recreational opportunities would enhance the recreational experience of the visitors. These measures could be developed through an interpretation and education plan for the project that includes provisions for the following: (1) construction and operation of the VIS at Baker Lake on lands within the Baker River Project boundary; (2) staffing the VIS from Memorial Day through Labor Day; (3) information about the project in relation to the environment, including recreational opportunities; and (4) how the needs of the disabled are considered in the design of the VIS.

We discuss the cost of the Upper Baker Visitor Information and Interpretive Services, and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

**Recreation Adaptive Management Fund**

Under Proposed Article 602, Puget would establish a Recreation Adaptive Management (RAM) Fund and contribute $50,000 annually to the fund beginning in 2006 for the duration of a new license. Under Proposed Article 602, some possible uses of the fund include: (1) additional measures to limit the impacts of dispersed recreation at Upper Baker development; (2) aesthetic enhancements to non-project facilities; (3) unusual trail and trailhead maintenance costs associated with natural events not under the control of the licensee; (4) increased development of the Bayview Campgrounds; and (5) monitoring dispersed recreation use adjacent to Lake Shannon.

*Effects Analysis*

Because the geographic scope of the proposed 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 find a nexus between project operations and the areas outside the project boundary that would be addressed by the RAM Fund. Furthermore, the proposed fund would be used at non-project facilities.

We discuss the cost of the RAM Fund and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

### *Secondary Effects of Proposed Measures*

#### Lower Baker Power Plant Modifications

The Proposed Action includes modifications at the Lower Baker powerhouse (section 2.2.1) requiring earth moving and construction activity. Public access is not allowed beyond the gate near the Lower Baker Visitors Center, so there would be no direct effect on recreational use. However, the construction activities may cause some disruption to visitors in the form of noise and construction traffic on the roads used to access areas with recreational use. Visitors may choose not to fish and picnic in the vicinity of the reservoir near the dam to avoid noise in the short term. Traffic could be disrupted if road closures are necessary for safety, and this may reduce public access during construction. These effects would only occur during the construction period of 2 years. It may be possible to minimize these effects by scheduling road closures and other disruptive activities during the middle of the week or in winter months.

#### Aquatic Resources Measures

The Proposed Action includes proposed articles related to fish passage, propagation, and enhancement. If the Proposed Action successfully increases fish populations in the reservoirs, visitors would likely have greater fishing success. This could draw more people to the project and increase occupancy at the developed facilities and dispersed-use areas around the reservoir. Increased use at developed and dispersed-use areas may increase the needs related to facility operation, maintenance, and replacement. Increased visitation may also cause more use of roads and trails, creating increased maintenance needs for these improvements.

#### Terrestrial Resources Measures

The Proposed Action includes proposed articles to enhance habitat for various terrestrial and aquatic species, including elk, amphibians, osprey, loons, cavity dwellers, and bald eagles. If these actions, such as acquiring land, developing management plans and installing structures, are successful and populations of these species become more abundant, visitors to the project would likely have greater opportunities to view wildlife and amphibians. This would likely cause visitors to have a better recreational experience at the project.

There are a few aspects of the proposed articles relating to terrestrial resources that may have secondary effects on recreational resources. Proposed Article 507 would require Puget to install and maintain floating nest platforms on the project reservoirs and

restrict public access with buoys or other demarcation structures. This proposed article would reduce the area where the public is allowed to boat on the reservoirs, and some visitors may resent losing access to the areas. However, depending on the size of the area that is restricted, some visitors may be able to view loons on the nesting platforms, increasing wildlife viewing opportunities for the public.

**Cultural Resources Measure**

Measures to protect cultural and historical properties are included in the Proposed Action. Proposed Article 201 sets forth a process to evaluate and protect these resources without site-specific references. Currently, there is no formalized, integrated plan for evaluating and managing historic and cultural resources associated with recreational facilities and activities at the project. The Proposed Action would establish a new process for historic and cultural resources management that may affect development of recreational facilities under the Proposed Action. If cultural or historical properties are present at proposed locations for development and if the review required by the Proposed Action reveals a conflict with recreational use, the scope or placement of proposed recreational developments could be affected. The effects could include a reduction in overnight capacity and the availability of lakefront campsites. New developments under the Proposed Action for recreation facilities such as trails, visitor education, and interpretive opportunities could be reduced or eliminated if cultural or historic resources are found during surveys and if it is determined that the proposed new recreational development or its associated visitor-use conflicts with their management. Cultural and historic resources would be an appropriate and interesting topic for visitor interpretation and education.

**Aesthetic Resources Measures**

Project facilities have an influence on the aesthetic/visual environment of the areas from which recreational users and other visitors can see them. Project facilities which can have an effect on the scenic integrity of their surroundings include the two project dams and their related facilities, the West Pass Dike (and nearby off-peak pump discharge pump station), the Upper Baker Operations and Maintenance Yard, and the Lower Baker River Operations Complex Center, at which the project visitors' center is located.

Under Proposed Article 302, Puget would develop an aesthetics management plan. Measures contained in the proposed article include the following: (1) paint the pump station (off peak pump discharge facility) in neutral earth-tone colors and plant native vegetation to screen the facility from the West Pass Dike boat launch; (2) plant native vegetation to screen the yards, buildings, and fence of the Upper Baker Operations and Maintenance Yards from the Kulshan Campground and Forest Service Road 1106; (3) paint the existing crane at the Lower Baker Dam a neutral earth-tone color during the

next normal painting cycle; and (4) plant landscaping in the area near the visitor's center and associated parking area at the Lower Baker River Operations Complex Center.

Under Proposed Article 302, Puget would provide funds to the Forest Service to implement the following measures for non-project facilities in the vicinity of Baker Lake: (1) vegetation management at Panorama Point, Horseshoe Cove, Shannon Creek, Bayview Campground, and Maple Grove Campground, and (2) vegetation management between Forest Service developed sites and/or viewpoints, and Baker Lake in two to four yet to be identified locations averaging less than 0.25-acre in size.

*Effects Analysis*

The proposed painting and vegetative screening at the Lower Baker dam crane, pump station, Upper Baker Operations and Maintenance Yard, and Lower Baker River Operations Complex would help to minimize the visual effects caused by those project features.

The specific vegetative management measures to be implemented at the Forest Service sites and the two to four locations averaging less than 0.25-acre in size are not identified in the proposed article. We, therefore, are unable to analyze the benefits of these measures.

We discuss the cost of the Aesthetic Management Plan and our recommendation in section 5.1, Comprehensive Development and Recommended Alternative.

#### 3.3.8.3 Unavoidable Adverse Effects

None.

#### 3.3.8.4 Cumulative Effects

Many past events have contributed to the existing condition relative to recreation in the Baker River watershed. Native Americans and homesteaders established the first area trails, which allowed foot and horse travel. In later years, mountain climbers also used these trails in their attempts to climb Mt. Baker and Mt. Shuksan. Additional routes were established with timber harvesting and the area then became accessible to vehicles. Even more roads were constructed with development of the project and the main route to the project, the Baker Lake Highway, was eventually paved which further improved the ease of access for the public and created recreational attractions in the form of large reservoirs.

The area draws visitors from nearby communities as well as the larger Washington cities that are located farther away from the project. As the population growth in these

communities has increased over time, recreational use at the project has also increased. In the 1950s as part of the Forest Service's mission to provide quality recreational experiences for the public, recreational facilities were constructed to accommodate this use and provide comfort and conveniences for visitors. Nearby, wilderness areas and national parks were established, protecting the area from further development, timber harvest, and road construction. The protections afforded these lands created places where people could enjoy solitude in a forested mountain setting, rely on their own physical and mental abilities, and visit a place where human-made features are not evident on the landscape. The trail systems were formalized and agencies with the authority to manage these areas were funded to improve and maintain the trails for public use. As public use of these lands continued to increase, the Forest Service and NPS instituted a permit system for wilderness visitors.

In the future, the main trend that would affect recreation at the project is the projected population increase in Washington. With an increase in population there would likely be increased urbanization of land near the project. As people live closer to the project, they have shorter distances to drive to recreate and this may translate into more people visiting the areas as well as more frequent visits from nearby residents. Increased visitation may cause public land management agencies to limit or redirect visitors (e.g., wilderness quotas, dispersed camping permit system) if recreation use grows and potentially affects natural resources or visitor experiences beyond acceptable limits. Also, there will likely be an increasing proportion of the public that will be participating in outdoor recreation activities. Specifically, the activities that are projected to have the greatest proportional increase over the next 20 years include: (1) nature activities, (2) walking, (3) visiting a beach, (4) picnicking, (5) canoeing/kayaking, (6) bicycle riding, (7) non-pool swimming, (8) sightseeing, and (9) hiking.

Continued presence of the project reservoirs would provide locations where demand for recreational activities with projected growth such as visiting beaches, swimming, and paddling may be accommodated. The project reservoirs would be an important component of the landscape that would contribute to meeting the needs for public recreation. The new trails that would be constructed under the Proposed Action would also contribute to meet the projected need for public recreation.

If agencies restrict visitation on lands adjacent to the project, displaced visitors may seek to use the project lands and waters. The Proposed Action may provide recreational alternatives for visitors who may not be able to use the adjacent wilderness and National Forest System lands if future use restrictions are imposed.

### 3.3.9 Aesthetic Resources

#### 3.3.9.1 Affected Environment

The project is set in a rugged forested basin of the northern Cascade Range, incised by the Baker River and its tributaries. At its mouth, the river basin transitions to the broader Skagit River valley. The aesthetic character of the area is mixed, reflecting both the natural setting and the effects of modifications from timber harvest, hydropower development, and the more urban characteristics of the Town of Concrete. The forested hillsides that dominate views in much of the project area are settings of outstanding natural beauty.

Two primary viewsheds comprise the project area, Baker Lake and Lake Shannon, along with a 1.2-mile reach of the Baker River within the Town of Concrete. Most visitors access the watershed on the Baker Lake Highway, which extends from Highway 20 (the North Cascades Highway) up the western side of the basin as far as the upper end of Baker Lake. A less maintained and less traveled road, the East Lake Shannon Road (or Baker River Forest Road), originating in Concrete, is the primary route to Lake Shannon. Numerous private, WDNR, and Forest Service roads provide limited access into the basin, although many of these roads are gated. From Baker Lake Highway, Lake Shannon is not visible, and Baker Lake is not visible until the road reaches Little Park Creek, shortly before transitioning to the unpaved Forest Road 11 that follows the shoreline to the head of the lake.

**Upper Baker Development**

Baker Lake is a narrow 4,800-acre, 9-mile-long reservoir located in the center of the Baker River watershed. It is set in dramatic terrain, surrounded by forested ridges rising to about elevation 4,100 feet msl on the west and 5,700 feet msl on the east side. The western ridges are the foothills of Mt. Baker (elevation 10,775 feet msl) and Mt. Shuksan (elevation 9,127 feet msl), which provide a backdrop to Baker Lake. The Western Hemlock Zone species form a continuous band around the eastern shore of the lake, extending to the western side where it is fragmented and interspersed with Pacific Silver Fir Zone species.

The Upper Baker Development lies within the Mt. Baker-Snoqualmie National Forest, with the exception of about 371 acres of land owned by Puget and IP Forestry on the southwest edge of the reservoir. The 1990 Forest Plan (Forest Service, 1990), as amended by the 1994 Northwest Forest Plan (Forest Service and BLM, 1994a), provide management direction for these lands. The Forest Plan uses the Forest Service Visual Management System, which includes standards and guidelines in the form of Visual Quality Objectives (VQOs) (Forest Service, 1974). The VQOs reflect various degrees of acceptable alteration of the natural landscape based upon the importance of aesthetics. The Visual Management System identifies five VQOs: preservation, retention, partial retention, modification, and maximum modification. Most of the Forest Service land in

the vicinity of the Upper Baker Development is assigned the VQOs of retention, partial retention, and modification. All forest lands around Baker Lake are designated as partial retention (Forest Service, 2002a), in which human activity may be evident, but should remain minimal to the natural landscape. Areas where timber has been harvested on ridges surrounding the lake have been assigned a VQO of modification, where human activity can dominate the landscape. The mountains to the east and west are designated retention, where management activities should not be visually apparent.

To examine the aesthetic influence of activities on its lands, the Forest Service further describes viewsheds. The Baker Lake viewshed is characterized by the Forest Service (1990) as "slightly altered" by human modifications, although tributary drainages of Sulphur Creek and Anderson Creek were classified as "heavily altered." Most landscape modification has occurred along the west side of the reservoir in conjunction with timber harvest and road construction. The most prominent feature in the viewshed is Baker Lake. Other project features are evident with many providing public access to shorelines. Upper Baker dam and Puget's Baker Lake Resort are less visible. Other developed features along the shore of the lake are six campgrounds managed by the Forest Service, West Pass dike, and the upper extent of Forest Road 11.

EDAW (2004b) selected 19 key viewing areas (KVAs) to represent the different types of scenery that visitors experience within the Baker River Project area, 17 of which are around Baker Lake (see table 3-41). The KVAs 1 through 13 and 16 through 19 are at Baker Lake, and all are shoreline sites, except Glover Mountain (KVA 13), Boulder Creek dispersed site (KVA 5), and Kulshan Campground (KVA 12).

Also shown in table 3-41 is a Scenic Integrity Rating of landscapes viewed from a KVA. The Forest Service (1995) utilizes a Scenic Integrity Rating to determine whether a facility fits into the character of its surrounding landscape and meets the expectations of area visitors. A facility rated as "high" or "very high" would indicate that it is physically or culturally affiliated with its setting, while a rating of "moderate" to "very low" would indicate that it is out of character or in conflict with a visitor's expectation.

Two primary project features are visible from at least one KVA, Upper Baker dam and the West Pass dike. Upper Baker dam is a 312-foot-tall concrete structure crossed by Forest Road 1100/1106. At its base is the rectangular Upper Baker powerhouse and outdoor switchyard (the switchyard is not a project facility). The Baker Lake fish collection facility, located upstream from the dam, is used to trap downstream migrating anadromous fish. Views of the dam are limited due to a steep narrow canyon and a 90-degree bend from the main body of Baker Lake. Only those driving across the dam and those visiting the remote Glover Mountain Overlook (KVA 13) would be expected to see the dam, which contrasts in material and form with the landscape.

The other Baker Lake impoundment structure is the West Pass dike, forming the 1,200-foot-long southwest embankment of the reservoir. It separates Baker Lake from the shallow Depression Lake. The dike is a visible feature from the adjacent Kulshan Campground (KVA 12) and the West Pass boat ramp (KVA 11). It is apparent to boaters on the southern part of Baker Lake.

Table 3-41. Description of key viewing areas within the Baker River Project area. (Source: EDAW, 2004b)

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 1: Baker River Trail trailhead and dispersed camp sites at river's edge, looking east | No project facilities visible. View dominated by open river, natural floodplain, and forested ridge. | Forest Service-conservation emphasis | Natural-appearing forest lands | Background = high to very high<br>Middle ground = high to very high<br>Foreground = very high |
| KVA 2: Shannon Creek Campground; boat launch area, looking east at east side of north end of Baker Lake | No project facilities are visible. Some regenerating clear-cut seen in background. View is dominated by reservoir. | Forest Service-conservation emphasis | Natural-appearing forest lands to naturally evolving forest lands (on old Forest Service clear-cut areas) | Background = high to very high<br>Middle ground = high to very high<br>Foreground = variable (by reservoir elevation) |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 3: Baker Lake Resort at top of boat launch, looking east | Boat launch, dock, and log boom are prominent foreground features. View comprises open reservoir, shoreline, and Cascade range. | Forest Service-conservation emphasis | Developed recreation and natural-appearing forest lands | Background = very high<br>Middle ground = high to very high<br>Foreground = variable by reservoir elevation |
| KVA 4: Panorama Point Campground at south edge of boat ramp, looking north to east | Boat launch is prominent in foreground. View is dominated by the open reservoir, Mt. Shuksan, other cascade peaks, some regenerating, and newer clear-cut on private lands to the north. | Forest Service, private timber companies<br>Forest Service-conservation emphasis<br>Private timber companies-management direction likely commercial forestry | Natural-appearing forest lands to naturally evolving forest lands (on old Forest Service clear-cut) | Background = high to very high<br>Middle ground = high<br>Foreground = variable by reservoir elevation |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 5: Boulder Creek Dispersed Area north of Boulder Creek mouth, looking north | No project facilities visible. View is dominated by reservoir shore vegetation, reservoir, and Mt. Shuksan. | Forest Service-conservation emphasis | Natural-appearing forest lands | Background = very high<br>Middle ground = high to very high<br>Foreground = variable by reservoir elevation |
| KVA 6: Boulder Creek at Boulder Creek Bridge, north end, looking east and west | No project facilities visible; bridge and road dominate foreground. East view is river, floodplain, and forest; west view is forest and Mt. Baker. | Forest Service-conservation emphasis | Natural-appearing forest lands | Background = very high<br>Middle ground = high to very high<br>Foreground = high |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 7: Lower Sandy Dispersed Area at middle of beach opening at end of road, looking east | No project features visible. Some regenerating clear-cut visible on ridges beyond reservoir. View dominated by open reservoir and shoreline, ridges beyond. | Forest Service-conservation emphasis | Natural-appearing forest lands to naturally evolving forest lands (on old Forest Service clear-cut) | Background = high<br>Middle ground = high to very high<br>Foreground = variable by reservoir elevation |
| KVA 8: Lone Pine Island at north edge of island, looking west and north | No project facilities visible. Some roads and clear-cut visible on the background ridges on Forest Service and private land. View dominated by the reservoir, shoreline, and ridges and peaks of the Cascades, especially Mt. Baker. | Forest Service, WDNR, and private timber companies<br>Forest Service-conservation emphasis<br>WDNR and private timber companies-management direction likely commercial forestry | Natural-appearing to naturally evolving forest lands (on old Forest Service clear-cut areas)<br>Commercial forest lands on WDNR and private timber company lands | Background = high to very high<br>Middle ground = high<br>Foreground = variable by reservoir elevation |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 9: Bayview North Campground at shoreline at end of access road, looking northwest to northeast | No project facilities visible. View is dominated by the reservoir and the Cascades. | Forest Service-conservation emphasis | Developed recreation facility and natural-appearing forest | Background = very high<br>Middle ground = high<br>Foreground = variable by reservoir elevation |
| KVA 10: Horseshoe Cove Campground at boat launch, looking north to east | No project facilities visible. Boat launch, swim beach, and log boom are prominent in the foreground. View comprises reservoir, shoreline, and ridges to east. | Forest Service-conservation emphasis | Natural-appearing forest lands | Background = high<br>Middle ground = high to very high<br>Foreground = variable by reservoir elevation |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 11: West Pass boat launch at shelter, looking north | Boat ramp, West Pass dike, and off-peak pump discharge buoy markers are visible. View generally consists of reservoir, shoreline, and prominent peaks. | US Forest Service FS and Puget<br>Forest Service-conservation emphasis<br>Puget-anticipates current management to be continued | Developed recreational facility, developed industrial, and natural-appearing forest lands | Background = very high<br>Middle ground = high<br>Foreground = variable by reservoir elevation |
| KVA 12: Kulshan Campground at west entry road, looking north | West Pass dike is visible in the foreground beyond the trees; project access road, operations facilities, and utilities are prominent features. | Forest Service and Puget<br>Forest Service-conservation emphasis<br>Puget-anticipates current management to be continued | Developed recreation facility and developed industrial | Background = high<br>Middle ground = NA<br>Foreground = moderately low |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 13: Glover Mountain Overlook, looking south | Baker Lake dam and primary switchyard are prominent features. Views beyond are of forested ridges and beyond to the Skagit Valley. | Forest Service, Puget, and private timber companies<br>Forest Service-conservation emphasis<br>Puget-anticipates current management to be continued; site improvements planned<br>Private timber companies-management direction likely commercial forestry | Natural-appearing forest lands, naturally evolving forest lands, developed industrial, and commercial forestry | Background = high<br>Middle ground = moderate<br>Foreground = low |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 14: Lower Baker River Operations Complex, near the Lower Baker Visitors Center at viewing platform atop fish trap below fish barrier dam | Puget fish trap and fish barrier dam are prominent facilities as are abandoned concrete silos. Baker River Bridge also dominant feature in far foreground. | Puget-anticipates current management to be continued | Developed industrial | Background = NA<br>Middle ground = moderate<br>Foreground = low |
| KVA 15: Lake Shannon boat launch ramp, looking west | No project facilities visible. Commercial forestry lands behind the reservoir very visible. View is dominated by shoreline, reservoir, and hills beyond. | Private timber companies and WDNR-management direction likely commercial forestry | Dispersed recreation and commercial forest | Background = moderate<br>Middle ground = low to moderate<br>Foreground = variable by reservoir elevation |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 16: Anderson Point dispersed area at shoreline at west side of point, looking south | West Pass dike is visible in middle ground, but not prominent. Lake and Mt. Baker to the west are prominent elements. Regenerating and newer clear-cut visible on WDNR and private timber lands to south. | Forest Service, Puget, WDNR, private timber companies<br>Forest Service-conservation emphasis<br>WDNR, private timber companies-management direction likely commercial forestry<br>Puget-anticipates current management to be continued | Natural-appearing forest lands to naturally evolving forest lands (on old Forest Service clear-cut) | Background = high<br>Middle ground = high to very high<br>Foreground = variable by reservoir elevation |
| KVA 17: Maple Grove dispersed area at shoreline end of floating dock, looking west | No project features visible. View is dominated by open reservoir, shoreline, and Mt. Baker in the background. | Forest Service-conservation emphasis | Natural-appearing forest lands | Background = very high<br>Middle ground = very high<br>Foreground = variable by reservoir elevation |

| Key Viewing Area | Major Prominent Aesthetic/Visual Features Observed from Key Viewing Area (Other than Reservoir) | Major Ownership of Viewed Lands and Future Management Direction | Landscape Character of Viewed Area | Scenic Integrity Rating of Landscape Viewed From Key Viewing Area |
|---|---|---|---|---|
| KVA 18: Silver Creek dispersed area at the south shore of the point, looking west. | Baker Lake Resort visible but not obvious, appears only as a break in the shoreline vegetation. View dominated by reservoir and Mt. Baker. Regenerating clear-cut seen. | Forest Service-conservation emphasis | Natural-appearing forest lands and naturally evolving forest lands (on old Forest Service clear-cut areas) | Background = very high<br>Middle ground = very high to high<br>Foreground = variable by reservoir elevation |
| KVA 19: Noisy Creek dispersed area at north point beach, looking north | No project facilities visible. View is dominated by reservoir and views of prominent Cascade peaks in the background. | Forest Service-conservation emphasis | Natural-appearing forest lands | Background = very high<br>Middle ground = high to very high<br>Foreground = variable by reservoir elevation |

**Lower Baker Development**

The Lower Baker River basin, in which Lake Shannon and the southern end of the project are located, is a wider, less confined valley. The river carved a narrow canyon through this valley, the lower elevations of which the 7-mile-long, 2,278-acre Lake Shannon is located. The Lake Shannon viewshed is framed by the densely forested hills that rise approximately 4,300 feet on the east and 1,075 feet on its west side. Coniferous vegetation, primarily Douglas-fir, dominates the forests and is interspersed with mixed deciduous and other coniferous species. Beyond the margins of the reservoir, modification by timber management, natural fires, and, to a lesser extent, hydroelectric facilities are evident. The Lake Shannon landscape has been altered more by timber management activities than has the Baker Lake viewshed, with second- and third-growth forests dominating the basin.

State and private ownership dominates the Lower Baker Development area, which results in a pattern of commercial forest harvest. For further discussion see the Land Management and Use section in this draft EIS.

The 285-foot-high concrete Lower Baker dam impounds Lake Shannon, spanning a steep-sided forested gorge. Approximately 1,500 feet downstream, a concrete powerhouse is built into the steep hillside. It is topped by a blue crane. A single-lane road extending along the bank of the Baker River allows vehicle access up the narrow river canyon. Between the dam and powerhouse, a concrete surge tank emerges from the tree tops. These features are visible only from the unpaved Baker River Forest Road, and then only if a traveler pulls off at a small overlook.

The Lower Baker River Operations Complex and Visitors Center are downstream from the dam. This site, designated as KVA 14, is a collection of wood and metal-sided buildings housing project offices, maintenance facilities, and a Visitors Center, as well as paved parking areas. These facilities are adjacent to the Baker River, where a low concrete barrier dam directs upstream migrating fish to the project's fish collection and transport facility.

The only developed public access point on Lake Shannon consists of an informal access road (controlled by Glacier Northwest), a large gravel lakefront undefined parking area, and a boat ramp. Located on the southeast end of the lake, it has been designated as KVA 15. The approximately 2-acre open gravel and grassy area is used by dispersed vehicle campers and day users. Puget provides portable restrooms and site maintenance. No developed facilities are available. Views from KVA 15 are of rugged forested slopes rising from Lake Shannon with Cascade foothills and Mt. Baker in the background.

**Project Operations**

Baker Lake and Lake Shannon are managed for hydropower generation, flood control, recreation, and fisheries. Reservoir pool levels fluctuate seasonally in response to flood management requirements, power generation demands, natural inflow, and recreation objectives. Under average water year conditions, Puget typically drafts Baker Lake between October and March and Lake Shannon between December and March to meet power generation demand and to create storage space for high-runoff winter storms and spring snow melt. From November 15 through March 1, Puget holds Baker Lake to a maximum elevation of 711.56 feet msl for flood management (see the Water Quantity section herein). No similar requirement applies to Lake Shannon.

Baker Lake is held near full pool (elevation 727.77 feet msl) during the summer and reaches its lowest levels between November and early April. Based on median values, the lake is kept within 10 feet of full pool from June to August, typically reaching its lowest point in the winter months. EDAW (2004b) photographically documented the visual effects of reservoir levels from 4 to 15 feet below Baker Lake's full-pool elevation, as summarized below:

- Elevation 723.75 feet msl and higher - This range is within 4 feet of full pool and typically occurs between mid-June and early October. Very little shoreline is exposed at this level, and beaches and swimming areas are inundated.
- Elevation 722.75 to 718.25 feet msl - This range is from 5 to 9 feet below full pool, typically between late May and early July and again in September and October. A narrow band of exposed shoreline is visible around much of Baker Lake, with more exposure occurring on the shallower western shore and at the head of the lake. Beaches are accessible, although at the lower end of this range, the popular beach at Horseshoe Cove is less attractive.
- Elevation 717.75 to 713.75 feet msl - This range is from 10 to 14 feet below full pool when Baker Lake is being filled in spring (early to mid-May) or lowered in late fall (late October to early November). The northern part of the reservoir and the western shoreline is especially exposed, and large areas of tree stumps are visible. Limited recreation use occurs during these periods.
- Below elevation 712.75 feet msl - Baker Lake is drawn down to this level, 15 feet below full pool, from late November until March 1 for flood control purposes. Extensive shoreline areas are exposed as a striking light-colored band below the dense shoreline vegetation.

Lake Shannon is maintained close to its full pool level of elevation 442.35 feet msl throughout much of the year under average conditions. Based on median monthly water levels, historically Lake Shannon was within 10 feet of full pool from June to December.

Monthly median levels were within 5 feet of full pool elevation from July to September and November. The lowest monthly median level was approximately 33 feet below full pool and occurred in March. Documentation of the aesthetic condition of Lake Shannon at various water levels was not collected during relicensing studies. Lake Shannon is not considered as visually sensitive because it receives only 10 percent of project area recreational use and it is visible from very few locations.

#### 3.3.9.2 Environmental Effects

**Effects of Project Operations**

In general, the project blends well with its natural surroundings. To confirm this conclusion, Puget commissioned an aesthetic study (EDAW, 2004b) and a Recreation Visitor Survey (Huckell/Weinman Associates, 2004c). The latter survey established viewing scenery/sightseeing as the most popular project area activity. Ninety-five percent of the 723 respondents rated the overall visual quality of the Baker Lake/Lake Shannon area as above average or excellent. Visitor satisfaction also rated highly, with nearly 91 percent of respondents rating their experience as above average or excellent. When asked about the importance of reservoir level to their experience, only 30 percent responded to the question, out of which 58 percent indicated that pool level had no influence on their visit. Another 10 percent indicated that pool level reduced the aesthetic quality of the area. When asked what they least liked about their trip, only 4 percent of respondents identified pool level as a negative attribute. In response to a question about what could have improved their trip, of the 41 percent answering, none mentioned pool levels.

Puget sought to confirm these findings by evaluating project features from KVAs (see table 3-41), along with surveying visitors to correlate pool elevation with scenic attractiveness (EDAW, 2004b). Survey respondents were asked to rate 27 images of Baker Lake at four different pool elevations (see Project Operations section herein), as well as one image of Lake Shannon at elevation 433 feet msl. The 186 completed surveys all reflected positive responses. The two highest Baker Lake water levels received the highest average scores, but no clear reservoir elevation preference emerged. A subsequent correlation analysis resulted in a score of 0.136, indicating a very weak positive relationship between pool elevation and viewer preference. Based on these results, very little relationship between scenic attractiveness and pool elevation can be established.

EDAW (2004b) conducted an evaluation of four Baker Lake pool elevations, representing conditions from 4 to over 15 feet below full pool, on the scenic integrity rating of KVAs located near project reservoirs. Views most influenced by reservoir levels from the KVAs are those directly in front of visitors. Table 3-42 identifies the scenic integrity rating of these foreground views. Predictably, the quality of each setting

declines with the water surface. At lower pool elevations, tree stumps, trash, exposed mud flats, and beaches are exposed at the reservoir perimeters. Facilities such as boat ramps and concrete barriers that are underwater at higher pool levels are revealed at low pool, contributing to the reduced scenic integrity of Baker Lake at lower pool levels.

Table 3-42. Effects of project operations on key viewing areas at Baker Lake. (Source: EDAW, 2004b).

| | **Scenic Integrity Rating of Foreground Shoreline by Pool Level Elevation Range (feet msl)** | | | |
|---|---|---|---|---|
| **Key Viewing Area** | **723.75 feet and above** | **722.75 to 718.75 feet** | **717.75 to 713.75 feet** | **712.75 feet and less** |
| KVA 2: Shannon Creek Campground boat ramp | High | Moderate | Low | Very low |
| KVA 3: Baker Lake Resort at top of boat launch, looking east | High | Moderate | Moderate | Low |
| KVA 4: Panorama Point Campground boat ramp | High | Moderate | Low | Very low |
| KVA 5: Boulder Creek dispersed area north of Boulder Creek mouth, looking north | High | Moderate | Low | Low |
| KVA 7: Lower Sandy Dispersed Area at middle of beach opening at end of road, looking east | High | Moderate | Moderate | Low |
| KVA 8: Lone Pine Island at north edge of island, looking west and north | Very high | High | Moderate | Low |

| Key Viewing Area | Scenic Integrity Rating of Foreground Shoreline by Pool Level Elevation Range (feet msl) | | | |
|---|---|---|---|---|
| | **723.75 feet and above** | **722.75 to 718.75 feet** | **717.75 to 713.75 feet** | **712.75 feet and less** |
| KVA 9: Bayview North Campground | Very high | Moderate | Low | Low |
| KVA 10: Horseshoe Cove Campground | High | Moderate | Low | Low |
| KVA 11: West Pass boat launch | High | Moderate | Low | Very low |
| KVA 16: Anderson Point dispersed area at shoreline at west side of point, looking south | Very high | High | Moderate | Low |
| KVA 17: Maple Grove dispersed area at shoreline end of floating dock, looking west | Very high | High | Moderate | Low |
| KVA 18: Silver Creek dispersed area at the south shore of the point, looking west | Very high | High | Moderate | Low |
| KVA 19: Noisy Creek dispersed area at north point beach | Very high | High | Moderate | Low |

Similar data were not collected at KVA 15 on Lake Shannon, but it is to be expected that foreground views would be affected similarly by the water surface level changes.

*Effects Analysis*

Following the installation of the new generating units at Lower Baker and the initiation of the flow regime (Proposed Article 106), Baker Lake would be drafted later in the fall and refilled earlier in the spring than currently occurs to meet targeted recreational pool levels. Baker Lake water surface levels would be higher 65 percent of the time in September as fall drawdown would be delayed. In April, the lake level would be more than 10.5 feet higher and in May, more than 18 feet higher than current conditions. Water surface levels would be within 3 feet of full pool under both the Proposed Action and Current Operations from June through August. Scenic integrity ratings could be expected to increase from low to high in September, from low to moderate/high in May. The variability in water surface levels in April would result in a low scenic integrity rating under median conditions, similar to Current Operations. Summer elevations, those most observed by project area visitors, would not change perceptibly, and, therefore, the visual experience would be unchanged from Current Operations.

At Lake Shannon, variations in reservoir levels can be identified with higher pool levels from October through February, more variable levels in April and May, and levels similar to current conditions the remainder of the year. Reservoir management would not be changed substantially during the peak summer season and would not adversely affect the aesthetic experience of visitors.

The 1.2-mile-long reach downstream from Lower Baker dam would be unaffected by reservoir operational changes, but to the extent that visitors view the Baker River from this area, additional flow would be present under the Proposed Action. Under Current Operations, flows in this reach generally range from approximately 80 cfs to 5,172 cfs, while under the Proposed Action the range would be from 1,000 cfs to 5,600 cfs. The visual effect on this reach would be substantial, with higher flows in all months when modeled for 90 percent exceedance. The higher volume of water in the confined channel would add depth over the rocky substrate, giving the channel a more uniform appearance.

**Effects of Project Facilities**

The effect of project facilities on the aesthetic experience of visitors, particularly at lakeshore locations, was identified as an issue during the scoping process. Descriptive assessments are presented in this section and in table 3-43, with technical assessments compiled in table 3-44. Where a facility or viewpoint is on Forest Service-managed land, its scenic integrity rating and VQO compatibility are identified (table 3-44).

Topography of the Baker River area and locations of the developed facilities are such that views of facilities are restricted. When facilities are viewed, it occurs in proximity. Only five project facilities are considered visible to area visitors, as

summarized in table 3-43. Furthermore, these facilities can be seen from only six of the 19 KVAs (table 3-44).

**Upper Baker Development**—The mottled gray concrete surface of Upper Baker Development is similar in color to the rock walls of the gorge. Views of the dam are limited by its setting. It can be seen from Baker Lake, although a tight bend in the lake blocks the view for most boaters. The Glover Mountain Overlook (KVA 13) and Forest Road 1106/1000 across the top of the dam are the primary public viewpoints. Also visible from both of these locations is the Upper Baker fish collection facility, a floating structure anchored to the upstream face of the dam. In combination, these features result in a low scenic integrity rating (EDAW, 2004b).

Depression Lake and its associated pump station, located adjacent to West Pass dike, are visible to visitors at Kulshan Campground (KVA 12) and boat launch (KVA 11). West Pass dike is a prominent visual feature from FR 1106/1000 and parts of the Kulshan Campground, and appears as a solid horizontal line to boaters on Baker Lake. Its appearance contrasts with the surrounding forest, although the vegetation partially screens it from the campground. Depression Lake is very visible from the campground as a natural lake, while the pump station stands out in color and form. The scenic integrity ratings of these highly visible features are moderate for Depression Lake and low for the West Pass dike and pump station. West Pass dike is barely visible from the Anderson Point dispersed use area (KVA 16); scenic integrity ratings from this site are not compromised by the dike.

Table 3-43. Visibility of project features. (Source: EDAW, 2004b).

| Facility | Comments | Facility Visible from Key Viewing Areas and Use Areas |
|---|---|---|
| Upper Baker Dam and Powerhouse | Visible from very limited area (undeveloped canyon below dam, Glover Mountain Overlook, and dam access road).<br>Highly visible where seen due primarily to contrast in size and shape.<br>View duration is short term. | Glover Mountain Overlook<br>Forest Road 1106/1100 at dam |
| West Pass Dike | Major visual feature visible from a number of nearby locations in an area that is largely developed.<br>Long, high horizontal form contrasts in shape, form, color, and texture with nearby landscape and reservoir.<br>Off-peak pump building and chain-link fence contrast with surroundings.<br>Primary viewers are campers, boaters, and anglers.<br>Duration of view is medium to long. | Anderson Point Campground<br>Kulshan Campground, West Pass boat launch<br>Forest Road 1106<br>Reservoir surface |
| Upper Baker Operations Compound | Visible from the main access road leading to the Upper Baker dam, Kulshan Campground, and Glover Mountain Overlook.<br>Fenced maintenance equipment and buildings contrast with surroundings.<br>Upper Baker service station building burned to the ground in 2004. One of five structures visible to public.<br>Primary viewers range from passersby on the road to campers.<br>Duration of view ranges from transitory to extend over several days. | Glover Mountain Overlook<br>Forest Road 1106<br>Kulshan Campground |
| Lower Baker | Visible from limited area. | Lake Shannon Road |

| Facility | Comments | Facility Visible from Key Viewing Areas and Use Areas |
|---|---|---|
| Dam and Powerhouse | Short view duration, limited to passersby; no associated recreational use area. | |
| Lower Baker River Operations Complex | Visual feature visible from the main highway.<br>Long, low barrier dam and associated fish trap contrast with generally natural shoreline vegetation in shape and texture.<br>Primary viewers are travelers on the road and visitors stopping at the Lower Baker Visitors Center.<br>Duration of view is short term. | Lower Baker Visitors Center<br>Highway 20 |

Table 3-44. Effects of project facilities on key viewing areas from which project features can be seen. (Source: EDAW, 2004b).

| Key Viewing Area | Project Facilities Seen from Key Viewing Area | Scenic Integrity Rating of Landscape Viewed from Key Viewing Area | VQO and Facility Compatibility[a] | Comments |
|---|---|---|---|---|
| KVA 11: West Pass boat launch | West Pass dike, pump station, and buoy markers are visible | Foreground – low (variable by reservoir elevation) Middle ground – high Background – very high | NA | Project facilities are prominent visual features - difference of form, color, and texture from surrounding forest makes them visible. The dike, pump station, and buoy markers are visible and have a minor negative effect on the scenic integrity of the foreground view from this KVA, which is low. |
| KVA 12: Kulshan Campground | West Pass dike, Upper Baker operation and maintenance yard; Upper Baker service station building burned to the ground in 2004. One of five structures visible to public. | Foreground – low Middle ground – NA Background – high | NA | These project facilities are prominent visual features in the foreground of the campground entrance, although partly obscured by trees. They contribute (along with other visible features) to a scenic integrity rating in the foreground of low. |

| Key Viewing Area | Project Facilities Seen from Key Viewing Area | Scenic Integrity Rating of Landscape Viewed from Key Viewing Area | VQO and Facility Compatibility[a] | Comments |
|---|---|---|---|---|
| KVA 13: Glover Mountain Overlook | Upper Baker dam and associated generation facilities | Foreground – low<br>Middle ground – low<br>Background – high | NA | Primary viewpoint for observing the dam. These facilities contrast in form, line, and texture with the gorge and contribute (along with other visible features such as clear-cuts) to a scenic integrity rating in the foreground and middle ground of low. |
| KVA 14: Lower Baker Visitors Center | Fish trap, barrier dam | Foreground – moderate<br>Middle ground – moderate<br>Background – NA | NA | Viewpoint developed as interpretive exhibit to explain function of fish trap and barrier dam. These facilities contribute to a scenic integrity rating in the foreground of moderate. |
| KVA 16: Anderson Point dispersed area | West Pass dike | Foreground – very high<br>Middle ground – high to very high<br>Background – very high | VQO = Partial Retention. Compatible with VQO. | Barely visible in middle ground as a long stretch of shoreline. Has no influence on the scenic integrity rating of the landscape seen from this KVA. |

| Key Viewing Area | Project Facilities Seen from Key Viewing Area | Scenic Integrity Rating of Landscape Viewed from Key Viewing Area | VQO and Facility Compatibility[a] | Comments |
|---|---|---|---|---|
| KVA 18: Silver Creek dispersed area | Baker Lake Resort[b] | Foreground – very high<br>Middle ground – high to very high<br>Background – very high | VQO = Partial Retention. Compatible with VQO. | Visible in middle ground as break in shoreline vegetation. Has no influence on the scenic integrity rating from this KVA. |

[a] If seen from Forest Service managed facility or on Forest Service managed land.

[b] Not a project facility but managed by Puget on Forest Service land.

Across the road from Kulshan Campground is the Upper Baker operation and maintenance yard. A chain-link fence prevents public access but does not screen views of the large gravel lot, pumps, metal buildings, and storage yard. It has a negative effect on views from Kulshan Campground, and therefore has a low scenic integrity rating (EDAW, 2004b).

**Lower Baker Development**—Lower Baker dam rises 285 feet out of a narrow forested gorge. A concrete powerhouse, surge tank, and blue equipment crane are adjacent to the river downstream from the dam. All contrast with the color, line, and texture of the forested canyon walls. Facilities are visible only from a viewpoint on the Baker River Forest Road, a location that receives little visitation. The scenic integrity rating is considered low (EDAW, 2004b).

The Lower Baker Operations Complex (KVA 14) includes a paved parking area, several wood- and metal-sided buildings, a Visitors Center, and upstream fish collection facilities. This cluster is on the eastern edge of the Town of Concrete and is reached by a paved road. The fish facility and its adjacent low concrete barrier dam are visible from the nearby Highway 20, although only briefly due to typical travel speeds. Overall, this complex has a scenic integrity rating of moderate (EDAW, 2004b).

Aesthetic resources in the project area would be enhanced under Proposed Article 302, Aesthetics Management Plan. The proposed plan would include provisions for landscaping; material and color selection for facility modifications; and site maintenance programs. Specific actions are proposed to enhance the appearance of the West Pass dike area, Upper Baker operation and maintenance yards, the existing crane at Lower Baker dam, and the Lower Baker Operations Complex Center.

#### *Secondary Effects of Proposed Measures*

Construction associated with several proposed measures potentially could affect project aesthetics. These measures are discussed below.

#### Lower Baker Power Plant Modifications

Under the Proposed Action, a new powerhouse would be constructed adjacent to the existing Lower Baker powerhouse. This 170- by 100-foot concrete structure would use the foundation of a former powerhouse, reducing the need for clearing and grading. This structure would range from 34 to 70 feet tall, and the existing gantry crane rails would be extended about 180 feet for installation and maintenance of the new turbines. Access improvements would be needed; therefore, a short platform would extend from the existing access road to the upstream side of the existing powerhouse. This would be a more visible new feature from the overlook on the Baker River Forest Road, as it would extend into the confined channel of the Baker River. Like the existing facilities, these

new features would contrast with the surrounding forest; however, all elements of the scenery from this viewpoint include industrial features. With Lower Baker dam in the background, this area has been zoned industrial by the Town of Concrete. The new project facilities, therefore, would be consistent with existing facilities and aesthetic conditions.

**Aquatic Resources Measures**

**Fish Propagation Facilities**—Under Proposed Article 101, facilities to expand the production capacity of the spawning beaches would be constructed. Puget proposes to decommission Spawning Beaches 1, 2, and 3. Facilities would be constructed in proximity to existing propagation structures. This action would occur within fenced and gated areas currently inaccessible to the public. Public access would continue to be restricted to specially arranged tours or educational events.

As discussed in the Cultural Resources section in this draft EIS, Spawning Beach 1 and Spawning Beach 2 are contributing elements to the Baker River Hydroelectric Development Historic District. Spawning Beach 3 is a noncontributing element of the Historic District. Since Spawning Beaches 1 and 2 are contributing elements, Puget should consult with the Washington SHPO prior to decommissioning Spawning Beach 1 and Spawning Beach 2.

**Upstream Fish Passage Facilities**—Puget currently operates an upstream fish collection facility in the Baker River adjacent to its Lower Baker Operations Complex. This facility would be replaced or modified under Proposed Article 103. Until a location and design have been developed, the aesthetic effect cannot be determined. The area in which it would be located has been zoned industrial by the Town of Concrete. It is expected that the new collection-and-transport facility would appear similar to existing structures and aesthetic conditions.

**Downstream Surface Collectors**—Puget currently operates FSCs that attract out-migrating salmon at Upper and Lower Baker dams. Under Proposed Article 105, these facilities would be modified. Aesthetically, these features appear pieced-together and temporary. The proposed upgrades may lessen this impression, particularly if uniform materials and colors are considered during construction. These are industrial facilities and their appearance would always reflect this purpose. The upgraded facility at Lower Baker would include a new fish transfer structure, potentially on the dam.

Construction of these facilities would require development of an FSC launch site on Baker Lake and on Lake Shannon. The Baker Lake FSC launch site would be approximately 6,000 feet upstream from the dam at the site of an existing non-public boat launch, and potentially would be visible from KVAs 11 and 16. From both sites, it would be seen as a distant background element. The Lake Shannon FSC launch site would be

more visually pronounced because the existing boat launch area would be used. This site, KVA 15, would be significantly affected by the excavation, construction and operation of the fish passage fabrication site, with disturbance potentially lasting for 2.5 years.

Construction of stress relief ponds near the confluence of the Baker and Skagit rivers would be part of Proposed Article 105. Although siting and design specifics are unavailable, it is anticipated that these ponds would be excavated below grade with a paved perimeter to facilitate truck access. Perimeter fencing would preclude public access. In addition, an outfall channel or pipe would extend from the pond(s) to the river.

#### 3.3.9.3 Unavoidable Adverse Impacts

None.

### 3.3.10 Land Management and Use

#### 3.3.10.1 Affected Environment

The project vicinity is a rural setting in the Cascade foothills. Forest lands in the lower foothills, which were initially harvested between 1900 and 1950, now support commercially mature stands of timber (Whatcom County, Washington, 2004). Some residences and farms are found in the lower elevations of the river basin, outside the Town of Concrete (or Concrete), a nearby community. The Upper and Lower Baker dams are respectively about 8 miles and 1 mile north of Concrete. From this community, two primary roads lead into the Baker River basin: the Burpee Hill Road, which leads from Concrete to the Baker Lake Highway, and a gravel secondary road, which leads to the east side of Lake Shannon. For further discussion see Land Uses and Access below.

The project area is located within the Baker River watershed except for a portion below Lower Baker dam, which is considered part of the Skagit River watershed. Federal agencies (Forest Service and NPS) manage an estimated 86 percent of the Baker River watershed; the remainder is in state and private ownership. Recreation and natural resource management are the primary uses of public land, while commercial timber production is the predominant use of private land.

#### Land Ownership and Management

The Upper Baker Development lies entirely in Whatcom County and is surrounded by National Forest System lands within the Mt. Baker-Snoqualmie National Forest. To the south, the Lower Baker Development lies primarily within unincorporated Skagit County and the Town of Concrete, occupying a mix of state and private lands (table 3-45).

**Federal**—Federal land ownership is extensive at the Upper Baker Development, including 4,539.7 acres inundated by Baker Lake and 591.5 upland acres. Only 75.6

acres (inundated and upland) in the Lower Baker Development area (in Whatcom County) are federally administered. Federal lands adjacent to Baker Lake are managed in accordance with the direction of the Mt. Baker-Snoqualmie National Forest LRMP (Forest Service, 1990) and the Northwest Forest Plan (Forest Service, 1994a). These adjacent lands are designated as late successional reserve (LSR) to protect and enhance habitat for species associated with this habitat, most notably the northern spotted owl. Management objectives within this designation permit limited silviculture. For further discussion see the Terrestrial Resources section in this draft EIS.

Table 3-45. Approximate land and water area within the Baker River Project boundary. (Source: Puget Sound Energy, Inc., 2004)

| Project Area Component | Acres |
|---|---|
| **Upper Baker** | |
| Baker Lake reservoir area | |
| Puget ownership | 325.2 |
| Forest Service ownership | 4,539.7 |
| Other private ownership | 112.0 |
| Subtotal reservoir area | 4,976.9 |
| Land area (all Whatcom County)[a] | |
| Puget ownership | 270.9 |
| Forest Service ownership | 591.5 |
| Other private ownership | 99.8 |
| Subtotal land area | 962.2 |
| Upper Baker total reservoir and land | 5,939.1 |
| **Lower Baker** | |
| Lake Shannon reservoir area | |
| Puget ownership (Skagit County) | 2,234.5 |
| Forest Service ownership (Whatcom County) | 20.7 |
| WDNR ownership (Skagit County) | 3.3 |
| Other ownership (Skagit County) | 14.7 |
| Subtotal reservoir area | 2,273.2 |
| Land area[b] | |
| Puget ownership (Skagit County) | 220.0 |
| Forest Service ownership (Whatcom County) | 54.9 |
| WDNR ownership (Skagit County) | 1.5 |
| Other ownership (Skagit County) | 38.1 |
| Subtotal land area | 314.5 |
| Lower Baker total reservoir and land | 2,587.7 |

| Project Area Component | Acres |
|---|---|
| **Baker River Project** | |
| Reservoir area | 7,250.1 |
| Land area | 1,276.7 |
| Project total | 8,526.8 |

[a] Includes the area between elevation 727.77 feet (NAVD 88), the normal full-pool level for Baker Lake, and elevation 732.77 feet (NAVD 88), which defines the project boundary for most of the Upper Baker Development, along with other areas within the project boundary.

[b] Includes the area between elevation 442.35 feet (NAVD 88), the normal full-pool level for Lake Shannon, and elevation 445.47 feet (NAVD 88), which defines the project boundary for most of the Lower Baker Development, along with other areas within the project boundary.

The Baker River above Baker Lake was identified as suitable and eligible for inclusion in the Wild and Scenic River System in the 1990 Mt. Baker-Snoqualmie National Forest Forest Plan. The Forest Plan recommended the first 2.1 miles of the river above Baker Lake as a "Scenic" segment and the upper 11.2 miles (within the North Cascades National Park) as a "Wild" segment. Baker River was found to possess outstandingly remarkable scenery, fisheries, and wildlife values. Noisy Creek, from its headwaters to Baker Lake (6.1 miles), was recommended for "Wild" designation based on wildlife and ecological values. The Forest Plan requires protection of the outstandingly remarkable values of these rivers in order not to preclude a future designation. Although Congress has not adopted these recommendations, the Forest Service manages the corridors as if the designations were in place.

Two areas within the watershed, comprising 46 percent of the land, are designated as wilderness: the Mt. Baker Wilderness to the northwest of the project and the Noisy-Diobsud Wilderness to the east (Forest Service, 2002a). West of Baker Lake is the Mt. Baker National Recreation Area. The Skagit River Wild and Scenic corridor is due south of Lake Shannon, roughly paralleling Highway 20. This designation, established in 1978, classifies the Skagit River as a "Recreational" river. The Forest Service is interested in activities within the Baker River watershed as to their effect on the Skagit River and its "outstandingly remarkable" values (letter from J. Phipps, Forest Supervisor, Mt. Baker-Snoqualmie National Forest, Forest Service, Mountlake Terrace, Washington, to L. Pernela, Manager of Licensing, Energy Production and Storage, Puget, Bellevue, Washington, dated July 22, 2002). Because the latter designation was adopted after the development of the Baker River Project, the values for which the corridor is managed reflect conditions at the time of designation, and therefore, include the effects of project operation.

**State**—There is a small amount of state-owned lands within the project boundary. The WDNR administers approximately 5,000 acres in parcels to the east and west of Lake Shannon. The parcels range in size from about 40 to 640 acres. WDNR's forest lands are managed in trust for the benefit of institutions of the state of Washington, including schools and universities. Its lands in the project vicinity are part of the North Puget Planning Unit, covered by an HCP (WDNR, 1997) to maintain and conserve habitat for the northern spotted owl and other species. In addition to habitat protection, WDNR harvests timber for commercial products. An additional 4.8 acres of Washington Department of Transportation land lie within the project boundary, in the form of the road surface and ballast for Highway 20.

**Counties and Town of Concrete**—While the Lower Baker Development is partly within the boundary of the Town of Concrete, some of Puget's proposed measures could include development activities within unincorporated Skagit County. The town has adopted the Skagit County Shoreline Master Program for development within its shorelines. The stakeholders note that Skagit County's Shoreline Master Program and implementing regulations would apply to any portion of the Proposed Action that would occur in unincorporated Skagit County, as a part of the Coastal Zone Management Consistency determination process.

The Upper Baker Development is within the boundary of Whatcom County, on National Forest System land. The stakeholders note that federal lands are exempt from regulation under Whatcom County's Shoreline Master Program. The Forest Service would continue to evaluate the special use permit for the project during the term of any license.

**Private**—Private lands owned by entities other than Puget are located adjacent to the project boundary on the southwest side of Baker Lake and around Lake Shannon. Ownership is primarily industrial forest product firms such as IP Forestry and Crown Pacific, as well as Glacier Northwest, which operates a quarry. Some of these entities allow public use of their roads at certain times of the year for recreational access. Dispersed camping also occurs on some private land.

**Puget**—Project features in the Upper Baker Development area primarily occupy federal land, but Puget owns 270.9 acres in the Upper Baker area. Included within this is a 75-acre gated area on which Upper Baker dam, powerhouse, and an operations compound are located. Below the dam, at the confluence of the Baker River and Sulphur Creek, Puget maintains a gravel access road to the Spawning Beach 4 and fish rearing facilities. These two facilities are on National Forest System land, operated by Puget under a special use permit.

Puget's ownership is more extensive in the Lower Baker River basin, including approximately 2,234 acres inundated by Lake Shannon. The Lower Baker River

development occupies a narrow corridor extending south from the Lower Baker dam into the Town of Concrete. The dam, powerhouse, and surge tank occupy approximately 70 acres. The powerhouse is approximately 1,500 feet downstream from the dam, linked by a 1,410-foot-long buried penstock. Puget's offices and maintenance yard, approximately 0.75-mile downstream from Lower Baker dam, occupy 6 acres. The 0.2-acre Lower Baker Visitors Center features a fish handling facility, informational exhibits, restrooms, and public parking adjacent to the river.

**Land Uses and Access**

Historical use of the Baker River basin can be traced to the fur trading era of the early 1800s followed by intensive exploration by miners in the 1870s (Puget, 2002b). The extraction of gypsum, clay, and lime rock from sources in the Baker River drainage (materials used in the production of cement) became a successful commercial enterprise. The first cement plant in the Pacific Northwest was developed in Concrete in 1906, and a second was operational by 1920; together they employed 400 workers. Cement was produced in the area until 1967 (Town of Concrete, 2003). Raw materials were hauled from the Upper Baker River basin via rail and then by overhead trolley after construction of the Lower Baker dam blocked the rail line. This rail line supported timber harvesting in the basin by the early 1920s. Development of the Lower Baker River project in 1924 to 1925 helped meet the growing demand for electrical energy from the local and regional economy. Other historical land uses in the basin include an early effort to sustain fisheries in the region when the State of Washington developed a sockeye hatchery at the historical location of Baker Lake in about 1906. Later assumed by the U.S. Fish Commission (now FWS), this facility was operational until 1937.

Commercial and industrial land uses currently include hydropower, timber production, and retail/services. Puget has operated hydropower facilities on the Baker River since 1925. In 1990, the Covanta Hydro Operations West's Koma Kulshan Project began operation on Rocky and Sulphur creeks, discharging into Sandy Creek, a tributary of Baker Lake. These are the only industrial uses currently occurring in the upper basin. In the lower basin, Puget's hydropower facilities and several quarry sites are the remaining industrial uses. The Town of Concrete provides retail and service outlets.

The project supports fish production and rearing facilities on and adjacent to both Baker Lake and Lake Shannon. In the vicinity of Channel Creek in upper Baker Lake, three artificial spawning beaches have been constructed; two remain operational but are used only as auxiliary facilities. At the head of Lake Shannon on Sulphur Creek, Spawning Beach 4 has been operated since 1989. Adjacent to it is a large multi-species fish production facility.

Commercial timber production remains a major land use in the lower basin, where private and state-owned timberland dominate the lower to mid-elevations. Public and

private forestlands at these lower elevations are managed primarily for production of softwood lumber in harvest rotations of 45 to 60 years. Commercial harvesting on federal lands in the upper watershed peaked in the 1960s. As the acreage of mature forest on public land declined, the effect on species dependant upon this habitat was acknowledged in the Northwest Forest Plan (Forest Service, 1994a). Because of shifts in Forest Service management objectives, no timber products are currently being removed from National Forest System lands (Forest Service, 2002a), except small amounts of firewood, Christmas trees, cedar products, and hazard tree removal from campgrounds and road corridors.

Opportunities for both developed and dispersed recreation occur in the Baker River basin. The project reservoirs provide boating and fishing opportunities in a natural setting that attract many recreationists. National Forest System lands surrounding Baker Lake are designated either Roaded Natural or Semi-primitive Motorized (Forest Service, 2002a). Most lands on the east side of Baker Lake are designated by the Mt. Baker-Snoqualmie National Forest Forest Plan as suitable for Semi-primitive Motorized recreation, reflecting motorized boat use on the lake. Such uses may not be consistent with the Northwest Forest Plan LSR objectives or the Aquatic Conservation Strategy (ASC). The predominant effect of motorized boating would be noise, which would not be expected to interfere with either the ACS or development of old-growth characteristics in LSR areas. Lands to the west of the lake are designated as Roaded Natural, accessible by the primary road system (the Baker Lake Highway).

The regional population continues to grow and is expected to place increased recreational pressure on the natural attributes of the area. Currently, nine developed recreational sites in the basin provide approximately 300 campsites. Day-use and overnight facilities, described in the Recreation Resources section herein, are operated by both Puget and the Forest Service. In addition, approximately 213 dispersed campsites were identified by Puget, most within 0.25 mile of the project boundary and along the Baker Lake Highway, primarily in the upper part of the river basin (Huckell/Weinman Associates, 2004d). Recreational use of the Lake Shannon area is significantly less than that of Baker Lake because lands surrounding Lake Shannon are privately owned, access is restricted, and the terrain is rugged.

Access to the Baker River basin is via Highway 20, seasonally one of the main east-west routes across the Cascade Mountains that interconnect with Interstate 5. Baker Lake Highway is the principal roadway extending north from Highway 20 into the project area. Maintained by Skagit County (up to the Skagit/Whatcom county line), this paved road follows a route roughly parallel to the lakes and then continues about 0.5 to 1.0 mile to the west. Where the highway enters the national forest, it leaves county jurisdiction and becomes Forest Road 11. Approximately 4 miles from its terminus, the road brings travelers near Baker Lake. The remaining few miles of the road are gravel-surfaced. Spur roads from this corridor lead to various Baker Lake access points.

Access to Lake Shannon is limited. No public roads extend from the Baker Lake Highway to the west shore of Lake Shannon. On the eastern side, the gravel Baker River Road extends from Concrete to the vicinity of Lower Baker dam. This unpaved road proceeds north beyond the Lower Baker River Project facilities, where a primitive spur switchbacks down steep terrain through private property to the Lake Shannon boat ramp. Glacier Northwest owns the spur and the property surrounding Puget's recreation site. Glacier Northwest's property is a currently inactive limestone quarry, with two primitive roads that extend to Puget's boat ramp. One is the steep spur described above; the other is a gated road along the lakeshore from Lower Baker dam. Limited access northward on the slopes above Lake Shannon is available on a poorly maintained road, although through-access by the public along this road is not possible because most of the road is private and a damaged bridge over Thunder Creek (approximately two-thirds of the way up the lake) has not been replaced.

#### 3.3.10.2 Environmental Effects

**Effect of Project Operations**

Under the Proposed Action, operational changes would not alter areas of inundation, change the flood management protocol, or permanently introduce new facilities in previously undisturbed areas. However, some new facilities, including fish acclimation ponds and an upper basin visitor information station, are proposed but final locations have not been determined; therefore, they are not analyzed here. This section describes the effects of continued project operation on three issues identified in the scoping process: (1) effects on farmland; (2) proximity of WDNR lands to the project; and (3) effects on the Skagit River Wild and Scenic corridor recreational uses.

**Farmland in Baker River Basin**—Preservation of farmland from encroaching urbanization is an important issue to many in Skagit County. As development increases, conflicts arise between established agricultural uses and non-agricultural uses and industries. Skagit County planning ordinances (Chapter 5, Agricultural Resource Policies) specifically seek to preserve this local economic base (Skagit County, 2000).

Ongoing operation of the project does not affect farmland in the Baker River basin. The Proposed Action contains several terrestrial habitat management measures that would involve acquisition of lands or easements to protect specific types of habitat, some of which typically are provided by farms. The limited amount of farmland in the Baker River basin is within areas zoned by Skagit County as Industrial Forestland.

*Effects Analysis*

Implementation of terrestrial resource measures (proposed articles 502, 503, and 504) potentially could affect farmlands in the basin. None would convert lands to developed uses. Under Proposed Articles 502 and 504, Puget proposes to acquire land or

establish conservation easements for specific forest or wetland habitat types, respectively. Under Proposed Article 503, Puget proposes to purchase 300 acres of elk forage habitat. However, as discussed in the Terrestrial Resources section, we believe Puget should enhance or acquire lands as close to the project as possible. Therefore, we do not expect the above proposed measures to significantly affect farmlands, since none are present in the immediate project vicinity.

**Location of Project Lands in Relation to WDNR Lands and the Need for Leases or Rights-of-Way**—Lands within the project boundary, other Puget-owned lands, and WDNR-managed lands are depicted on figure 5-42 of the license application (Puget Sound Energy, Inc., 2004), as are other ownership categories. Puget proposes to modify the existing Baker River Project boundary within the Town of Concrete. The proposed action would remove 0.7 acre of undeveloped WDNR land from the project and, therefore, return jurisdiction to WDNR. The remainder of WDNR land is along the shoreline of the Lake Shannon reservoir in several isolated locations where the project boundary may cross onto WDNR land.[32] Detailed surveying of the project boundary in these locations would be needed to identify and remedy boundary and ownership discrepancies.

*Effects Analysis*

Until detailed surveys of the project boundary are conducted, terrestrial habitat management lands are identified, and recreation trail corridors are clearly identified, the potential to occupy WDNR lands cannot be determined.

**Project Effects on the Values for Which the Skagit River Wild and Scenic Reach was Designated**—The Baker River flows into a reach of the Skagit River designated in 1978 for protection as a recreational segment of the Wild and Scenic River. A waterway designated under this category is considered to have recreational values that would attract regional visitation. The Forest Service manages this reach in partnership with non-federal parties, reflecting a diversity of ownership along the corridor. The reach is managed to protect fish and wildlife, primarily anadromous fish and the federally-listed bald eagle.

*Effects Analysis*

The primary influence of the Baker River Project on the Skagit River is its flow release regime, which has been in effect since prior to the Wild and Scenic River designation. The Proposed Action would sustain a regime that provides the same flood control requirements as under Current Operations and as under those operations in

[32] Puget (2004) notes that it is likely that the WDNR lands along the reservoir depicted in Exhibit G of its license application as within the Project boundary, may not in fact be in the Project boundary because of small overlaps in data sets in Puget's GIS mapping.

existence in 1978. Modeled flow projections indicate that the monthly hydrograph would closely match Current Operations. When the hourly time-step is examined, project-induced flow fluctuations in the Skagit River level would be reduced in number and magnitude in comparison to current conditions (see Effects of Project Operations in this draft EIS). These overall differences are minor in comparison to the magnitude of flows in the Skagit River and demonstrate that the Proposed Action would improve operating conditions compared to those at the time of Wild and Scenic River designation for fisheries. Recreational values of the Skagit Wild and Scenic River would not be adversely affected by the project.

### Effects of Proposed Project Boundary Modification

Under the Proposed Action, Puget proposes to redraw its existing Baker River Project boundary to remove some land below the Lower Baker facilities that are not used for project purposes. Currently, within the Town of Concrete, the FERC project boundary extends across both sides of Highway 20. Under its Proposed Action, Puget proposes to remove 38.5 acres from the FERC project boundary. As itemized in table 3-46, included within this block of land are parcels owned by Puget, WDNR, WDOT, and three private parties. Puget notes that it has contacted each party in writing about its proposal and no objections have been received. Puget's consultation with each landowner is ongoing.

None of these lands are used for project-related purposes nor are they managed by Puget to benefit any specific resource values. They are not used for project O&M, flowage, recreation, federally listed species protection, cultural resource protection, or shoreline control, nor are they managed for fish and wildlife habitat. None have been developed for public access. Highway 20, a major cross-state highway, is the only developed feature within these parcels, and the removal of WDOT's 4.8-acre tract from the FERC project boundary would not alter its ability to manage the highway right-of-way. All other parcels are unimproved, supporting only a few primitive gravel roads and an abandoned gravel pit.

Table 3-46. Parcels proposed for removal from project boundary. (Source: Puget Sound Energy, Inc., 2004)

| Parcel Owner | Parcel Size (acres) | Current Land Use |
|---|---|---|
| Puget | 4.2 | Unimproved vacant lot. Not subject to any project-related management plan. |
| L. Marquette | 6.0 | Privately owned unimproved vacant lot. Not subject to any project-related management plan. |
| Puget | 13.2 | Unimproved vacant lot; site of former gravel extraction enterprise. Not subject to any project-related |

| Parcel Owner | Parcel Size (acres) | Current Land Use |
|---|---|---|
| | | management plan. |
| E. and V. Gates | 6.8 | Privately owned unimproved vacant lot. Not subject to any project-related management plan. |
| WDNR | 0.7 | State-owned unimproved vacant lot. Not subject to any project-related management plan. |
| Glacier Northwest | 2.8 | Privately owned unimproved vacant lot. Not subject to any project-related management plan. |
| Washington Dept of Transportation | 4.8 | Occupied by Highway 20 road surface and road ballast. Not used for any project-related purposes and not subject to any project-related management plan. |
| **Total** | 38.5 | |

#### 3.3.10.3 Unavoidable Adverse Effects

None.

### 3.3.11 Socioeconomic Resources

#### 3.3.11.1 Affected Environment

**The Region**—During the 19th century, coal mines, lumber mills, and industrial plants were developed throughout the region. In 1827 Hudson Bay Company was established and its traders explored the northern part of Whatcom County. In the late 1870's the commercial salmon and cod fishing industries began in Skagit County, and as a result, the canning and packing industry was established (Vleming, 2002). Fish processing plants were constructed on Bellingham Bay, Washington. In 1883 two railroads, Bellingham Bay and British Columbia Railroad Company, served the logging camps and mines for transport of the materials. During the late 19th and early 20th centuries lowland areas were cleared for farms. Potatoes, lettuce, celery, and peas were the primary crops; dairy, poultry, and seed (e.g., cabbage) production also contributed to the economy. In 1936, S.A. Moffet successfully started a pre-cooling process on 50 tons of peas, which led to construction of a plant in 1940 for freezing vegetables.

Today agriculture is a significant contributor to Washington State and the local economy, which we discuss below. Tourism, fishing, hunting, and other recreational activities also contribute to the economy. A recent survey (FWS and Census, 2002) indicates that among anglers, hunters, and wildlife-watchers, there is considerable overlap in activities. In 2001, 71 percent of hunters in Washington State also fished, and 27 percent of anglers hunted. If we look at one recreational activity for Washington State, the data shows that 12,841,000 days of fishing (residents and nonresidents)

occurred in 2001. In Washington, the total expenditure [33] for fishing in 2001 was $853,761,000. In Washington, survey results indicate that of the 66,105,000 wildlife-watching participants, 4,951,000 participants are disabled (FWS and Census, 2002).

The area surrounding the existing Baker River Project is lightly developed or undeveloped. The Baker River Project is located in Whatcom and Skagit Counties, Washington. These two counties define the environment for socioeconomic resources that may be affected by the Baker River Project.

**Whatcom County—**Whatcom County covers an estimated 1.3 million acres, of which approximately 80 percent (1.1 million acres) is forested or managed for forest resources. A significant portion of this total (877,000 acres) is under management either by the Forest Service-Mt. Baker-Snoqualmie National Forest, or the NPS-North Cascades National Park (Whatcom County, Washington, 2004).

There are 1,485 farms in Whatcom County totaling 148,027 acres. In 2002, the market value of agricultural products sold (referred to as "farm gate value") was $287,860,000 (U.S. Census Bureau, 2002). Whatcom County produces more blueberries and raspberries than any other county in Washington State and ranks second in the production of strawberries (Greater Whatcom Comprehensive Economic Development Strategy, as cited in Whatcom County, Washington, 2004).

The largest employing sectors in Whatcom County are education, health, and social services with 16,849 people; government with 12,275 people; retail trade with 11,595 people; and manufacturing with 9,807 people (U.S. Bureau of Census, 2000a). The Mt. Baker-Snoqualmie National Forest's contribution to the overall area economy is small. The Mt. Baker-Snoqualmie National Forest generates about 3 percent of the area's total employment and about 2 percent of the area's total income (Forest Service, 1990).

Tourism contributes to the local economy. Whatcom County, Washington (2004) states that visitors spend $333 million annually in Whatcom County and there are approximately 7,120 travel and tourism jobs in the county.

**Skagit County—**Skagit County covers an estimated 1 million acres. The largest employing sectors in the county are education, health, and social services with 8,488 people; manufacturing with 6,170 people; and retail trade with 5,925 people (U.S. Census Bureau, 2000b). Skagit County's accessible ports and refineries are important to the state's petroleum industry (Vleming, 2002).

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[33] Expenditures - money spent in 2001 for wildlife-related recreation trips in the United States and wildlife-related recreational equipment purchased in the United States. Expenditures include both money spent by participants for themselves and the value of gifts they receive (FWS and Census, 2002).

Agriculture is a significant contributor to the Skagit County economy (Andrews and Stuart, 2003). The primary agricultural commodities are dairy products; nursery and greenhouse; vegetables, melons, and sweet corn; and other crops (e.g., vegetable seed crops) (Andrews and Stuart, 2003). Skagit County ranks fifth in the state for producing green peas. Cabbage, beets, Brussels sprouts, and spinach seed are also grown. There are 872 farms in Skagit County totaling 113,821 acres. In 2002, the market value of agricultural products sold was $217,384,000 (U.S. Census Bureau, 2002). The agricultural sector employs 3,600 people (Vleming, 2002).

Andrews and Stuart (2003) find that tourism generates substantial revenue for Skagit County. Each April, for example, between 300,000 and 500,000 people attend the annual Skagit Valley Tulip Festival, an event sponsored by Skagit County tulip and other farmers. This event results in an annual direct economic impact of $14 million spent by participants plus indirect impacts of $2.8 million in wages, $192,000 in local tax revenue, and $848,000 in state tax revenue.[34] Thus, agriculture is important to the tourism industry. Recreation, wildlife viewing, and agro-tourism activities also contribute to the economy. Direct sales in Skagit County resulting from hunting, fishing, and other outdoor recreation activities contribute at least $500,000 to the county's economy.

For Whatcom and Skagit Counties, there are 5,946 and 1,971 housing units, respectively, for seasonal, recreational, or occasional use (U.S. Census Bureau, 2000a and 2000b).

Table 3-47 shows the economic characteristics of Whatcom and Skagit Counties; however, we caution the reader that information may differ between existing reports prepared by various agencies. Further, as a comparison with the counties, the median household income for the State of Washington was $45,776.

[34] Data is from the Skagit County Critical Areas Ordinance Draft Programmatic Environmental Impact Statement, February 2003, Skagit County Planning and Permit Center, Seattle, Washington, as cited in Whatcom County, Washington (2004).

Table 3-47. Economic characteristics of Whatcom and Skagit Counties. (Sources: U.S. Bureau of Census, 2000a and 2000b)

| | Whatcom County | Skagit County |
|---|---|---|
| Total Employment | 131,195 | 79,422 |
| Median Household Income[a] | $40,005 | $42,381 |
| Per Capita Personal Income[b] | $20,025 | $21,256 |
| Families Below Poverty Level | 3,231 | 2,161 |

[a] The term "income" can be related to "earnings." Earnings, as defined by the U.S. Census Bureau, are the algebraic sum of wage or salary income and net income from self-employment.

[b] Per capita personal income is the income that is received by persons from all sources. This measure of income is calculated as the personal income of the residents of a given area divided by the resident population of the area (U.S. Department of Commerce, Bureau of Economic Analysis).

According to the U.S. Bureau of Labor Statistics, the October 2005 unemployment rate for Washington State is 5.1 percent. Whatcom County is located in the Bellingham, Washington Metropolitan Statistical Area (MSA). The county's unemployment rate is 4.9 percent. Skagit County is located in the Mount Vernon-Anacortes, Washington MSA. The county's October 2005 unemployment rate is also at 4.9 percent. Due to the seasonal industries (e.g., agricultural sector) both counties have a tendency toward a seasonal variation in unemployment. Generally, these variations occur during the same months each year and are influenced by weather-related activities, such as harvesting.

**Population**—The State of Washington (2005) estimates Washington's population for 2005 is 6,256,400, an increase of 6.15 percent from the year 2000 (5,894,143 people). Various reports indicate that in-migration is a major component of the state's growth. Between 2000 and 2005 the elderly (65 years and older) increased from 662,148 to 712,092, which shows a gain of 7.5 percent. An increase in the elderly population is expected to continue due to the current number of people at or nearing retirement age.

The population for Whatcom County in 2005 is estimated at 180,800, an 8.38 percent increase from 2000. Currently, persons age 65 and over represent an estimated 11.6 percent (20,945) of the population. By the year 2025 the population age 65 and over is expected to increase to 19.2 percent (47,476). The primary cities in the county are Bellingham (72,320), Blaine (4,240), Ferndale (9,750), and Lynden (10,480) (State of Washington, 2005). (Population estimates are in parenthesis for both counties).

The population for Skagit County in 2005 is estimated at 110,900, a 7.69 percent increase from 2000. Currently, persons age 65 and over represent an estimated 14.4 percent (16,317) of the population. By the year 2025 the population age 65 and over is expected to increase to 19.7 percent (32,605). The primary cities in the county are

Anacortes (15,700), Burlington (7,550), Concrete (815), Mount Vernon (28,210), and Sedro-Woolley (9,800) (State of Washington, 2005).

Table 3-48 identifies population growth projections at 5-year intervals for Whatcom County and Skagit County. Washington State is included for a comparison. The table identifies low, intermediate, and high projections for the identified years.

Table 3-48. Population growth projections for Whatcom and Skagit Counties, Washington. (Source: Washington State, Office of Financial Management, 2002)

| | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| **Washington State** | | | | | |
| Low | 5,935,479 | 6,190,412 | 6,460,127 | 6,710,659 | 6,925,750 |
| Intermediate | 6,233,345 | 6,648,112 | 7,096,501 | 7,545,269 | 7,975,471 |
| High | 6,621,080 | 7,215,892 | 7,867,806 | 8,541,588 | 9,215,093 |
| **Whatcom County** | | | | | |
| Low | 171,665 | 181,330 | 192,721 | 202,601 | 211,182 |
| Intermediate | 180,463 | 195,504 | 213,246 | 230,228 | 246,636 |
| High | 194,449 | 217,009 | 243,634 | 270,518 | 297,813 |
| **Skagit County** | | | | | |
| Low | 106,914 | 113,902 | 121,467 | 130,891 | 139,253 |
| Intermediate | 113,136 | 123,807 | 135,717 | 150,449 | 164,797 |
| High | 121,451 | 137,054 | 154,785 | 176,627 | 198,992 |

#### 3.3.11.2 Environmental Effects

Puget does not propose any measures that are directed specifically to socioeconomic resources. In addition, no other stakeholders made any recommendations that specifically address socioeconomic resources.

*Effects Analysis*

The Baker River Project provides low-cost power to its customers, which provides a benefit to residents of Whatcom and Skagit Counties. Although there would be increased costs associated with implementing environmental, recreational, and cultural measures, the proposed project would have no adverse impacts on socioeconomic resources in the region.

Based on our independent analysis, we assume population increases to continue for the project-affected counties. The Baker River Project and its location in the river basin provide various recreational opportunities that, if a new license is issued, could contribute toward meeting future recreational needs as a result of projected population

growth. Consequently, a beneficial effect on Whatcom and Skagit Counties' economies would occur, thereby contributing to overall economic growth for Washington State.

#### 3.3.11.3 Unavoidable Adverse Effects

None.

## 3.4 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, Puget would continue to operate the Baker River Project under the terms and conditions of the current license. The environmental measures proposed in the Settlement Agreement would not be implemented, although the existing mitigation and enhancement measures (see section 2.1.3) would continue. Operation of the project under the current license would essentially maintain the natural resources of the Baker River basin in a "status quo" condition.

## 3.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Continued operation of the existing project under any of the alternatives considered, would continue to commit the lands and waters previously developed for energy production. This commitment of resources would not necessarily be irreversible or irretrievable because removal of the project dams and restoration of disturbed areas could return the project areas to near pre-project conditions. However, given the substantial costs and the loss of energy, recreational, and socioeconomic benefits, removal of the project is unlikely in the foreseeable future.

## 3.6 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Under all alternatives considered, the projects would continue to generate power for Puget's customers and provide recreational and socioeconomic benefits for the duration of any new license. The Proposed Action and staff recommended alternative would provide significant long-term protection and enhancement of biological, cultural, and recreational resources in the Baker River basin, although energy generation at the project would be somewhat reduced.