Office of
Energy
Projects

October 2004

Final Environmental Assessment

Willamette Falls Project
Oregon

FERC Project No. 2233

888 First Street, N.E., Washington, DC 20426

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Portland General Electric Company — Project No. 2233-043
Oregon

NOTICE OF AVAILABILITY OF FINAL ENVIRONMENTAL ASSESSMENT

In accordance with the National Environmental Policy Act of 1969 and Federal Energy Regulatory Commission's (Commission or FERC's) regulations, 18 CFR Part 380 (Order No. 486, 52 FR 47897), the Office of Energy Projects' staff has reviewed the application for a subsequent license for the Willamette Falls Hydroelectric Project located on the Willamette River, near the town of West Linn, Oregon, and has prepared a final environmental assessment (EA) for the project. The project does not occupy any federal or tribal lands. In the final EA, the Commission staff has analyzed the potential environmental effects of the existing project and has concluded that relicensing the project, with appropriate environmental protection measures, would not constitute a major federal action significantly affecting the quality of the human environment.

Copies of the final EA are available for review in Public Reference Room 2-A of the Commission's offices at 888 First Street, NE, Washington, D.C. The final EA also may be viewed on the Commission's Internet website (www.ferc.gov) using the eLibrary (formerly FERRIS) link. You may register online at www.ferc.gov/docs-filing/esubscription.asp to be notified via e-mail of new filings and issuances related to this or other pending projects. For assistance, contact FERC Online Support at FERCOnlineSupport@ferc.gov or toll-free at 1-866-208-3676, or for TTY, 202-502-8659.

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Magalie R. Salas
Secretary

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FINAL ENVIRONMENTAL ASSESSMENT FOR HYDROPOWER LICENSE

Willamette Falls Hydroelectric Project

FERC Project No. 2233

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
888 First Street, NE
Washington, D.C. 20426

October 2004

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SUMMARY

Portland General Electric Company (PGE) and Blue Heron Paper Company (BHPC) filed an application on December 27, 2002, for a new license to continue operation of the Willamette Falls Hydroelectric Project located on the Willamette River near the cities of Oregon City and West Linn, Oregon.

The Project has a total generation capacity of 17.5 megawatts (MW), 16 MW at PGE's T.W. Sullivan plant and 1.5 MW at the BHPC development. Generation at the BHPC development is used directly at the BHPC mill site. Generation from the T.W. Sullivan plant is used by PGE to meet energy demands within its service territory. The Applicants own most of the lands within the Project boundary as well as much of the adjoining lands.

PGE and BHPC used the Federal Energy Regulatory Commission's (FERC's or Commission's) alternative licensing procedures and filed an applicant prepared Preliminary Draft Environmental Assessment (PDEA) with an application for the new license. The PDEA evaluated the effects associated with continued operation and the issuance of a new license for the existing Project. Proposed measures have been identified for the protection and enhancement of environmental resources. These measures are focused on improving fish passage conditions at the Project and enhancing public appreciation and understanding of the history of Willamette Falls.

On August 28, 2003, PGE filed with the Commission a Supplement to its application, detailing protection and mitigation measures for a preferred alternative developed in consort with resource agencies and interested parties. The Preferred Alternative was the product of the parties' settlement discussions at the time of filing. It is the alternative that was analyzed in the Draft Environmental Assessment (DEA). Subsequently, on February 2, 2004, PGE filed an Offer of Settlement, which represents the agreement among PGE, five governmental, three tribal, and four non-governmental parties. The measures specified in the Settlement Agreement are consistent with those of the Preferred Alternative analyzed in the DEA.

On October 7, 2003, PGE and BHPC jointly requested Commission approval to transfer the license for the BHPC development to PGE. The Commission approved the transfer on November 17, 2003. PGE proposes to terminate generation at the BHPC facility and upon receipt of a new license for the Project, decommission the Blue Heron powerhouse. This FEA takes into account the decommissioning proposal for the BHPC mill site.

The main issues identified during the scoping process regarding fish passage at the Project include: providing safe downstream fish passage through the T.W. Sullivan Development and through the BHPC Development; lessening fall back rates of upstream fish migrants after passing through the fishway; improving downstream fish migrant

routes to allow safer passage past Willamette Falls; reducing delay or injury associated with locating fish ladder entrances; reducing predation risks during upstream fish passage past the project; providing suitable attraction flows at the fish ladder entrances; and reducing false attraction to turbine discharges.

The Settlement Agreement contains measures primarily associated with fishery resources and is based on a framework that includes the following components:

- Performance standards for downstream passage.
- A package of sequenced measures designed to increase the probability of achieving the agreed upon performance standards. Measures have been grouped into "Tiers" that reflect an implementation sequence where performance of a tier's measures become a key factor in the decision to implement the next tier of measures.
- A rigorous and comprehensive monitoring and evaluation program to ensure that performance standards are met.
- A process for reaching agreement on "next steps," if the initial package of measures fails to achieve the agreed-upon performance standards.
- Measures necessary to mitigate the Project's incremental impact on upstream passage.

Tier 1 includes measures that would be implemented prior to any new license order being issued. Tier 2 includes measures that would be implemented after any new license order is accepted. Tier 3 includes items that would be implemented in the event satisfactory performance was not achieved by items in Tiers 1 and 2. Tier 4 provides a mechanism for participants to reconvene and determine next steps in the event that performance is still not meeting standards after Tier 3 measures are completed. The Settlement Agreement measures for the Project would provide PGE the flexibility to improve fish passage at its facilities, while at the same time provide the Willamette Falls Settlement Agreement parties the necessary certainty regarding the level of fish protection that would be achieved.

Based on our independent analysis in this FEA, we recommend relicensing the project as proposed by PGE in the Settlement Agreement. Under PGE's settlement proposal, the Project would generate 121,471 MWh annually valued at $5,237,000 ($43) MWh) at an annual cost of $2,662,000 ($22 MWh), resulting in a net annual benefit of $2,611,000 (about $21 MWh).

We conclude that the Willamette Falls Project, as proposed by PGE in the Settlement, would be best adapted to a comprehensive plan for the proper use, conservation, and development of the Willamette River. In addition, we conclude that issuing a new license for the Project with the measures specified in the Settlement

Agreement, would not constitute a major federal action significantly affecting the quality of the human environment.

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FINAL ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office Of Energy Projects
Division Of Hydropower Licensing
Washington, D.C.

Willamette Falls Hydroelectric Project
FERC Project No. 2233, Oregon

I. APPLICATION

Portland General Electric Company (PGE) and Blue Heron Paper Company (BHPC) filed an application on December 27, 2002, for a new major license to operate the existing Willamette Falls Hydroelectric Project. The 17.5-megawatt (MW) Project is located on the Willamette River at approximately river mile (RM) 26 near the cities of Oregon City and West Linn, Oregon. The Project does not occupy any federally reserved lands. The Project generates an average of about 129,456,000 kilowatt hours (kWh) of energy annually (1996-2001). PGE and BHPC do not propose any new capacity or new powerhouse construction although there is major construction associated with several proposed environmental measures.

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II. PURPOSE OF ACTION AND NEED FOR POWER

The purpose of this action is to comply with the Federal Power Act (FPA), which requires a license for the construction, operation, and maintenance of non-federal hydroelectric projects. The need for this action is to provide a continuing and reliable source of electrical energy.

On October 7, 2003 PGE and BHPC jointly requested that the Commission approve transfer of the license of the BHPC development to PGE. PGE proposes to terminate generation at the BHPC facility upon receipt of a new license for the Project. The Commission approved this transfer on November 17, 2003.

A. Purpose of Action

The proposed federal action under consideration is the Federal Energy Regulatory Commission's (FERC) decision regarding the issuance of a new Project license for the Willamette Falls Project. In deciding whether to issue a license for a hydroelectric project, the Commission must determine that the Project will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued, the Commission must give equal consideration to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife including related spawning grounds and habitat; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Providing equal consideration to these resources balances the interests of the public, regulatory agencies, and the applicant.

This Final Environmental Assessment (FEA) is prepared pursuant to the National Environmental Policy Act (NEPA) and the FERC regulations. It describes and evaluates the potentially significant environmental effects of the proposed relicensing of the Willamette Falls Hydroelectric Project. The FEA assesses the effects of continued Project operation, including the no-action alternative, which is status-quo operation. It also assesses the effects associated with proposed measures to enhance fish passage conditions at the Project as well as recreational and cultural measures associated with improving public enjoyment and understanding of the Falls.

B. Need for Power

The power generated at the 1.5- MW BHPC Development is used within its industrial complex. By using the electrical energy generated at its powerhouse, the BHPC is able to reduce the amount of electrical energy it must purchase from other suppliers to meet its industrial energy needs. The continued need for this source of electrical energy is directly linked with BHPC operations.

The power generated at the 16.0-MW T.W. Sullivan Development is fed into PGE's electrical transmission and distribution system for use within its service area to help serve its customers. T.W. Sullivan comprises about 3.1% of PGE-owned generating capacity, but approximately 6.2% of PGE's energy generation due to the T.W. Sullivan's high capacity factor. PGE is part of the Western Electricity Coordinating Council (WECC), (formerly known as the Western Systems Coordinating Council, or WSCC), which is comprised of generators and suppliers in 12 western states, Canada, and Mexico. PGE and its resources are located within the northwest subregion of the WECC.

The WECC estimates that its peak summer demand will increase to about 163,000 MW by 2010. By 2010, this region will need 48,000 MW of new generation projects to maintain a 15-percent reserve margin, including 43,000 MW for load growth and 5,000 MW for retirements. Maintaining a similar reserve margin for the Pacific Northwest will mean developing and constructing approximately 5,700 MW of new generation projects by 2005, and 11,800 MW by 2010. Reaching the 2005 target requires proceeding with construction of 1,100 MW of projects, plus the 1,300 MW placed in service during 2001, and the 3,300 MW that are already under construction.

In summary, future WECC and Pacific Northwest reserve margins will be influenced by the amount of new generation placed in service, returning loads, including the Willamette Falls Project, retirements of existing units, and adequate hydro-electric water conditions.

III. PROPOSED ACTION AND ALTERNATIVES

A. Proposed Action

1. Project Facilities and Operation

The Willamette Falls Project is located within a highly-populated, industrialized urban setting in Oregon City and West Linn, Oregon, approximately 10 mi. from downtown Portland. Industrialization surrounds Willamette Falls and serves multiple public and private entities. Facilities located at the Falls include two power generation plants, a navigation lock, an upstream fish passage facility, and two paper mills. The Willamette River near the Falls also is an important source of recreation, including fishing, boating, and wildlife viewing. The river is accessible at a number of nearby parks, but the Falls themselves are not generally accessible due to surrounding industrialization. Willamette Falls represents a natural divide between the lower Willamette River, which is a tidal estuary and hydraulically influenced by the lower Columbia River, and the rest of the non-tidally influenced Willamette River basin.

a. Project Site Description:

The Willamette Falls Project is a run-of-river facility that is composed of two separate hydroelectric generating developments located on the east (Oregon City) and west (West Linn) sides of Willamette Falls. The developments together can produce and transmit 17.5 MW of power (16.0 MW at T.W. Sullivan and 1.5 MW at BHPC). Hydroelectric power has been generated at these sites for more than 100 years, beginning with PGE's Station A in 1889, and continuing at T.W. Sullivan (Station B) since 1895. Generation began at BHPC in 1916. Paper mill operations have also been present at the Falls for more than a century. Although no longer in operation, historically the area was also home to flour, saw, and pulp mill operations. The navigation canal and locks on the west bank of the river have been in operation since 1873, initially by the Willamette Falls Canal and Lock Company until 1916 when it was acquired by the U.S. Army Corps of Engineers (USACE) who have operated it since. The canal and locks provide 30 ft of lift for commercial barge transport and recreational boat traffic.

b. Project Lands:

The Applicants own most lands within the Willamette Falls Project boundary, as well as much of the adjoining lands. BHPC, West Linn Paper Company (WLPC), the City of West Linn, the City of Oregon City, and private landowners also own adjacent lands. Additionally, PGE leases lands to WLPC. PGE also leases land to the City of West Linn for Bernert Landing and a portion of Willamette Park. The only land within the Project boundary not known to be owned by the Applicants are two small state-owned parcels around the Falls, specifically a parcel just to the west of the Falls most upstream point that has on it Oregon Department of Fish and Wildlife (ODFW) fish ladder

structures and a section of the dam, and a section at the west side of the upstream end of the BHPC Mill Reserve basin that has on it a portion of the dam and access road.

c. Access Roads:

The T.W. Sullivan plant is located on an island, separated from the west bank by the USACE locks and canal. The site is reached from West Linn by a restricted access road serving T.W. Sullivan, WLPC, and the USACE. A single lane bridge across the locks provides the only pedestrian and vehicle access to T.W. Sullivan and the paper mill. The BHPC powerhouse is reached from Oregon City on a restricted access road that winds through the numerous structures of the BHPC paper mill.

d. Willamette Falls Dam:

The dam at Willamette Falls is essentially one long, horseshoe shaped structure that is about 2,300 ft in length with the elevation along most of its crest at 52 ft mean sea level (MSL), with shorter sections ranging in elevation from 52.5 ft MSL to 56.9 ft MSL. An additional 600-foot spillway section furthermost downstream on the Oregon City side has stoplogs installed on it to prevent overflow. It was constructed to increase the hydraulic head available for electric power generation and to direct lower river flows to the Project forebays on each side of the Falls. During periods of low river flows, the dam crest is raised by 2 ft using flashboards. These are designed to wash out during high flows in the fall and winter. The flashboards raise the water surface elevation in the forebay to provide for power generation as well as deeper water for river navigation, boat mooring, and a ferryboat service.

The Project is a run-of-river operation and does not provide useable water storage or flood control. No usable storage means that the Project does not store water above the dam for the purpose of withdrawing it at a later time. While there is no permanent storage created by the dam, the estimated live storage of the pool created by the additional backwater behind the dam structure during typical summer flows is estimated at approximately 16,300 and 13,800 ac-ft with and without the flashboards installed, respectively (Berger 2002). Results from CE-Qual-W2 computer models indicate that the pool influence extends upstream from river mile (RM) 26.5 to RM 56.0. The total volume, which includes the backwater and run of the river volumes, is approximately 50,000 ac-ft (Berger 2002). Under the range of normal operations, the water surface at the dam varies from approximately 54 ft MSL during low flow with the flashboards installed to about 58 ft during normal winter flows. Typical water surface elevations are in the range of 55-56 ft MSL.

Water that does not flow through one of the Project's two powerhouses, through the ODFW fish ladder, or through the navigation locks, simply passes over the Falls and proceeds down river. Water diverted through the powerhouses rejoins the main river immediately below the Falls. A notable feature of the Project area is that the tidal effect

of the Pacific Ocean is evident all the way to the base of Willamette Falls. The change in tailrace elevation from this tidal effect has a small but noticeable effect on hydroelectric generation by raising the tailrace and reducing hydraulic head differential.

e. T.W. Sullivan Powerhouse:

The T.W. Sullivan powerhouse is surrounded by WLPC mill facilities and is adjacent to the USACE navigation canal. It contains 13 vertical turbine-generators operated locally with remote monitoring at the PGE Westside Hydro Control Center, located near Estacada, Oregon. Except for emergency situations, Project operations during adverse and high water years do not differ from typical conditions. During higher flows, excess water in the T.W. Sullivan forebay exits through the siphon spillways adjacent to Unit 13 at the downstream end of the forebay. The siphon spillway was installed primarily to provide an automatic flow bypass should the entire plant suddenly shut down. It also provides additional spill capacity during high runoff conditions.

A continuous trashrack system spans the entire length of the forebay in front of the turbine intakes. The existing installation has 13 turbine-generator sections (units) consisting of one turbine and one generator per section. There are four different types of turbines at T.W. Sullivan:

- Unit 9 is a vertical Francis turbine rated at 1,200 hp at 240 rpm and 35 ft of head. The turbine has a hydraulic gate controller.
- Units 1 through 7 and 10 through 12 are vertical, adjustable-pitch, six-blade, propeller turbines. These turbines are rated at 1,600 hp at 242 rpm and 40 ft of head. The blade pitch can be changed to match the head conditions. These turbines are controlled with gate settings. The combination of gate position and blade angle is used to optimize the water use and to minimize cavitation. The propeller machines are normally operated only at full load.
- Unit 13 is a fixed, five-blade, stainless steel propeller type turbine that was installed in 1993. It is rated at 1,440 hp at 242 rpm and 40 ft of head.
- Unit 8 is a fixed, six-blade, stainless steel propeller type turbine that was installed in 1996. It is rated at 2,100 hp at 242 rpm and 40 ft of head.

Other facilities include a headgate structure with trash racks located at the entrance of the plant's forebay. The upstream end of the forebay extends underneath West Linn Paper's Grinder Room No. 2. A 25-foot high training wall in the forebay is part of the downstream fish guidance system constructed in 1975. The installation of the downstream migrant bypass system also involved a trashrack realignment and construction of a bypass capture area. The objective was to use the trashracks as a system to guide fish into Unit 13.

Initial operation of the generating developments at Willamette Falls did not provide any protection to downstream migrating salmon and steelhead. Those downstream migrants not going over Willamette Falls passed through one of the many turbines operating various industrial equipment.

This concern was evident during the licensing process to obtain the current FERC operating license for the Willamette Falls Hydroelectric Project. Significant effort, during and after the licensing process, was expended by the fish management agencies and the Project operators to address the downstream migrant protection issue. In the summer of 1959, studies of turbine-induced fish mortality were conducted on several of the Willamette Falls turbines, including one or more at each of the three companies. Further turbine mortality studies were conducted from January to February, in 1960 and 1961, at all three developments. At the T.W. Sullivan Development, Units 7, 8, and 9 were tested.

In 1974, after many years of discussion, PGE recommended a new bypass system, which was formally accepted by the resource agencies for installation and evaluation. The system involved trashrack realignment, an additional training wall, and a bypass capture area. The objective was to use the trashracks as a system to guide fish into Unit 13. Installation began in the spring of 1975 and was completed by the end of the year.

In 1978, after several years of testing, the ODFW requested that a bypass system be designed and installed in Unit 13 that would pass fish directly into the tailrace. PGE installed a stainless steel, wedge wire bar screen device to protect downstream migrants. Initial test results showed improved bypass performance; however, it was believed that the bypassed fish were still subject to injury as they were routed to a collection box used to evaluate the bypass facility. In 1985, the collection box itself was bypassed, and fish were passed directly into the tailrace and back to the river.

Throughout the 1980s, ODFW required both T.W. Sullivan and BHPC turbines to be shut down for six to eight weeks for fish protection. Additionally, if river flow, as measured at Salem, fell below 35,000 cubic ft per second (cfs) during peak migration periods, ODFW could, and did, mandate Project shutdown. Evaluation of the T.W. Sullivan bypass system evolved during this time and continued until 1991, when the existing fish bypass evaluator station was installed. The evaluator went into operation in 1992 with a formal PGE and ODFW study plan that is updated every year. ODFW has not required a shutdown of the T.W. Sullivan powerhouse since 1991.

f. Blue Heron Paper Company Powerhouse:

The BHPC Development also uses the dam at Willamette Falls and includes a powerhouse and forebay at the eastern end of the dam. The powerhouse intakes are located in a small bay in the upstream portion of the basin that was originally constructed for PGE's Station A. The powerhouse discharges into the main river channel just below

the Falls, immediately upstream of the BHPC paper mill site. The two horizontal, Francis-type, double runner turbines are rated at 1,100 horsepower at 32 ft of head. Unit 1 turbine operates at 240 rpm and Unit 2 turbine operates at 300 rpm. The intakes are provided with 16-foot-high trash racks and a headgate for each turbine. The BHPC Development contains two penstocks for its two horizontal turbines. The penstock for Unit 1 is 7.25 ft in diameter and the Unit 2 penstock is 8.5 ft in diameter. Both penstocks are constructed of riveted steel plates. Fish passage facilities are not present at the BHPC Development.

On October 7, 2003 PGE and BHPC filed an application to transfer the license of the BHPC project to PGE. The BHPC Powerhouse ceased operation in 2003, and PGE proposes to decommission the project by 2005. The Commission approved this transfer on November 17, 2003.

g. Transmission Lines And Substations:

Output from T.W. Sullivan is fed through a 16 MW, 57/4.16 kV transformer located on the powerhouse deck on top of the siphon spillway. A single-circuit transmission line carries the power to the switchyard and substation on the bluff above the plant, outside the Project boundary. There are no transmission facilities associated with the BHPC Development powerhouse and the output of its generator is fed directly in to a 2,300-volt service bus in the paper mill complex.

h. Fish Facilities:

The Willamette River supports many species of anadromous and resident fish, both native and non-native, all of which can be present in the Project area. Since 1885, various fish ladders have been constructed at the Falls to provide upstream adult passage past this natural barrier to salmon and trout. With operation of the many water-driven turbines at industrial facilities at the Falls, downstream passage for migrants has been, and still is, a concern. Over the years, downstream migrant protection has been provided by a combination of plant shutdowns, fish bypass system installation and modifications, and other improvements, such as devices to reduce gull predation.

Both upstream and downstream fish passage facilities are provided at Willamette Falls. Upstream passage is provided by ODFW while downstream passage protection, in several forms, is provided by the Applicants.

A simple fish ladder was first constructed in the bedrock walls of the Falls in 1885 using funds appropriated by the State Legislature. The existing adult fish ladder, owned and operated by ODFW, was partially funded by PGE (16.3%) as mitigation for raising the height of the dam. It is comprised of three separate ladders with four entrances (three within the Falls and one in the T.W. Sullivan tailrace), a trapping facility, and a viewing and counting facility where daily fish counts are made and video monitoring occurs.

The ladder has four entrances for adult migrants, with attraction water for each. It uses up to 1,080 cfs to operate, with each leg using from 32 to 48 cfs for fish transport, and from 300 to 450 cfs additional water for attraction. One entrance is located in the cul-de-sac arm of the Falls in the T.W. Sullivan tailrace. Unit 1 discharge provides attraction water at this entrance. The other three entrances are located inside the Falls, with attraction water coming from intakes above the Falls. All fish entering the ladder are guided into one section where the viewing chamber is located.

Environmental conditions have a significant effect on adult fish passage at Willamette Falls. Flows of 10,000 to 30,000 cfs (recorded upstream at Salem) are considered ideal for adult passage. Higher flows at the Falls can impede passage as entrances and attraction water become more diluted and increasingly difficult for fish to find. Water temperature may play a larger role than flow in adult passage; flow and temperature are related, with higher flows correlated to lower water temperatures. Water temperatures from 10 to 12.8°C stimulate migration for most salmonids. When flows and temperature are favorable, large concentrations of fish can move in short periods of time.

Several concerns are being addressed in the development of the downstream migration alternatives that are related to the ODFW fish ladder. First, attraction water for entrance #1 of the ODFW fish ladder is provided from operation of Unit #1 at T.W. Sullivan powerhouse. If Unit # 1, or the entire powerhouse is not generating, concerns have been raised about potential delays for upstream migrants that enter the tailrace area because they are not attracted to entrance #1. Second, the dam and flashboards have the potential to adversely affect upstream passage routes available to adult lamprey. Lamprey are not thought to be able to navigate through high velocity flows or up over right angles and may not be able to pass over the dam or flashboards when installed. The ODFW fish ladder and USACE locks provide alternate passage routes to adult lamprey. A third issue related to the ODFW fish ladder is understanding how changes in hydrology caused by proposed dam modifications, or screening structures, will affect the operation of the fishway (e.g., debris loading).

i. Current Downstream Passage:

Smolts emigrating from the Willamette River upstream of the Project encounter one of three primary exit routes: spill over the dam and Falls, through the T.W. Sullivan powerhouse, or through the BHPC powerhouse. Additional downstream routes include passage through the USACE navigation locks and ODFW fishway facilities. Emigration of fishes through the Project occurs during all months of the year, but 85% of downstream passage occurs during March-June (Normandeau Associates, Inc. 2001h). Most fish that emigrate through the Project area are passed over Willamette Falls. The presence of the dam around the crest of the Falls modifies flow patterns around and over the Falls by spreading out the flow around the entire Falls. This is most noticeable at lower flows (20,000 cfs and below of total river flow) where much of the flow may have been guided over the Falls through natural upstream channels through and between

Moore and Abernathy Islands. By spreading the flow around the entire crest of the Falls, some downstream migrants are deterred from passing at the Falls because only a shallow veil of water passes over the dam/flashboards. Also some flow passes over the Falls at locations that may result in injury from rock outcroppings or by landing on rocks at the base of the Falls. The effect of the dam on downstream passage during low flow conditions is difficult to measure, but it has been identified as a concern by participants in the relicensing process.

Smolts entering the T.W. Sullivan forebay during their downstream migration pass through forebay trashracks and turbines into the tailrace, or are guided along the trashracks through the forebay to Unit 13 where a turbine bypass screen system (Eicher screen) directs fish to the tailrace. Fish guidance efficiencies for bypass facilities at T.W. Sullivan are approximately 75% with direct mortality ranging from 4.5 to 4.8% (Normandeau Associates, Inc. 2001h).

Protection of smolts during downstream passage through the BHPC Development is provided by 1-in bar racks in the forebay and seasonal shutdowns during emigration periods in the spring. The current shutdown period has been in effect since 1995 and occurs for approximately 13 weeks during the mid-February to mid-June time frame. Available data suggests 84.5% of the combined run (all species and stocks) are protected from entrainment by the present spring shutdown regime (Normandeau Associates, Inc. 2001i). Mortality for those smolts that do enter BHPC during operational periods is estimated at 18.7%.

j. Willamette Falls Locks and Canal:

The locks operated by the USACE allow movement of commercial and recreation boat traffic past Willamette Falls. The series of four chambers (not counting the canal basin and guard lock) allows for movement of boats and barges up to 210 ft in length and 40 ft in beam with a 6-foot draft. Prior to 1996, the traffic was divided equally between commercial and recreational craft. Since then, commercial use has greatly declined and recreation craft now represent about 80% of the traffic. The navigation locks are closed for approximately 5 months during the late fall and winter periods.

2. Environmental Measures

The environmental measures being proposed were developed by the Applicants based on interaction with licensing participants during the alternative licensing process. The vast majority of these measures are associated with fishery issues.

The Applicants crafted fish protection, mitigation, and enhancement measures that are based on a framework that includes the following components:

- Performance standards for downstream passage.

- A package of sequenced measures designed to increase the probability of achieving the agreed upon performance standards. Measures have been grouped into "Tiers" that reflect an implementation sequence where performance of a tier's measures become a key factor in the decision to implement the next tier of measures.
- A rigorous and comprehensive monitoring and evaluation program to ensure that performance standards are met.
- A process for reaching agreement on "next steps," if the initial package of measures fails to achieve the agreed-upon performance standards.
- Measures necessary to mitigate the Project's incremental impact on upstream passage.

Based on the above framework and discussion with participants, tiered modification packages were developed. Tier 1 includes measures that would be implemented prior to the new license order being issued. Tier 2 includes measures that would be implemented after the new license order is accepted. Tier 3 includes items that would be implemented in the event satisfactory performance was not achieved by items in Tiers 1 and 2. Tier 4 provides a mechanism for participants to reconvene and determine next steps in the event that performance is still not meeting standards after Tier 3 measures are completed.

Participants agreed that measured performance within an agreed upon range would involve working to improve the performance of measures already implemented. Measured performance below the agreed upon range, would involve implementing the next tier of measures. As part of an adaptive management approach, participants would remain involved in the post-implementation performance testing and subsequent actions based upon the testing results.

Measures associated with non-fishery resources, specifically recreation and cultural resources, are described at the end of this section.

B. SETTLEMENT AGREEMENT

On February 2, 2004, PGE filed an Offer of Settlement, which represents the agreement of five governmental, three tribal, and four non-governmental parties. The fisheries Performance Standards and Goals; Consultation and Decisionmaking (Fish Technical Committee); and PM&E measures are contained in the Settlement Agreement. Exhibits A, B, and C of the Settlement Agreement contain Proposed License Articles, a Relicensing Implementation Plan, and Interim Measures, respectively. The description of the proposed action contained in this FEA is consistent with the Settlement Agreement. The following PGE's proposed measures are grouped by their location and resource area. By sequencing the fish protection measures in a tiered approach, improvements can be

determined after each measure is evaluated against a performance standard to determine if modification is needed to the measures implemented or if the next tier of measures need to be implemented.

1. Downstream Passage

a. W. Sullivan Powerhouse:

Juvenile Salmonids

Measures to address juvenile salmonid passage at the T.W. Sullivan powerhouse are:

1. Make necessary modifications to Unit 1, 2, 3 forebay trashracks and forebay guidewall, as identified through physical forebay modeling, to improve forebay hydraulic characteristics (2004).

2. Install and operate an additional downstream migrant bypass route through the North siphon bypass, adjacent to Unit 13, designed to pass at least 500 cfs of flow directly from the forebay to the tailrace (2005/2006).

3. Install and operate a forebay trashrack cleaning system to ensure the forebay trashracks remain free of debris build-up that could adversely affect fish guidance efficiency (FGE) and downstream migrant survival (2005/2006).

4. When selected unit shutdowns are necessary, first shut down units that have the least effect on forebay hydraulics, as determined through physical forebay modeling. Subsequent FGE testing may identify different units to selectively shut down (2004).

5. Limit maintenance shutdown of Unit 13, which provides downstream migrant bypass capability, to no longer than 2 weeks during the period July 1 to August 1. Powerhouse operation during a maximum 2-week Unit 13 shutdown during this period will not require agency permission. Continued powerhouse operation during Unit 13 shutdowns longer than 2 weeks during this period, or Unit 13 shutdowns outside of this period, will require agency permission (2005).

6. Modify Unit 12 and 13 discharges to eliminate potential aquatic predator habitat (2006).

7. Upgrade avian predation deterrents in the powerhouse tailrace (2006).

8. Install new passive integrated transponder (PIT) detector technology at the Unit 13 bypass and siphon bypass to ensure fish passage efficiency and

survival can be effectively measured and to guide decisions consistent with the tiered management approach (2005/6).

9. Modify Unit 13 bypass outfall to meet National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) hydraulic impact velocity criteria (2006).

10. Replace runners in Units 1–7 and 10–12 at a rate of two per year beginning in 2004 unless otherwise agreed to through consultation with the Fish Technical Committee (FTC). Replaced runners will be index/efficiency tested and operated, in accordance with an operating plan developed by PGE in consultation with fish agencies, within a 1% band around peak efficiency for the existing hydraulic conditions (based on 48-hr average) until forebay FGE is at least 95% for salmonid smolts and fry and juvenile Pacific lamprey. Mortality testing, within 1 year of replacement and prior to additional unit replacements, will be conducted for any runner design different than that installed in Unit 8 (2004).

11. Operate existing turbine runners, in accordance with an operating plan developed by PGE in consultation with fish agencies, within a 1% band around peak efficiency based on manufacturers' curves for the existing hydraulic conditions (based on 48-hr average) until forebay FGE is at least 95% for salmonid smolts and fry and juvenile Pacific lamprey.

Juvenile Salmonid Fry

PGE, in consultation with the FTC, will develop and implement an evaluation program to determine salmonid fry guidance efficiency and survival through the T.W. Sullivan powerhouse after implementation of the Tier 2 siphon bypass measure. This evaluation will consider impacts of fish bypass routes and turbine passage.

Downstream Juvenile Pacific Lamprey

PGE, in consultation with the FTC, will develop a joint evaluation study program covering juvenile Pacific lamprey. PGE and the FTC will work together to develop the studies that PGE will fund and implement to address the following:

1. In 2004, determine the rate of impingement of juvenile Pacific lamprey on the existing Eicher screen utilizing juvenile Pacific lamprey from mainstem Columbia River bypass systems.

2. Determine Pacific lamprey guidance efficiency through the T.W. Sullivan powerhouse after implementation of the Tier 2 siphon bypass measure.

3. Estimate the potential impact of the T.W. Sullivan powerhouse to juvenile Pacific lamprey based on guidance efficiency and turbine mortality after implementation of Tier 2 measures.

4. Determine additional improvements to passage conditions using the information gained through the above evaluations and other relevant information to determine additional improvements to passage conditions at the Project site for PGE to implement.

To achieve the goal of safe passage for juvenile Pacific lamprey, PGE, in consultation with the FTC, will implement additional measures identified by these studies as appropriate to reduce injury and mortality of Pacific lamprey that pass through the T.W. Sullivan powerhouse, as well as through the controlled flow structure at the Willamette Falls apex.

Adult Salmonids (Kelts and Fallback)

PM&E measures applicable to the protection of adult salmonids are:

1. Remove several outer headgate trashrack bars on the west (West Linn) end to facilitate downstream passage of adult salmonids that are observed in this area.

2. Assess the condition of adult salmonids that pass downstream through the T.W. Sullivan powerhouse and take measures identified as appropriate to ensure safe and timely passage of these fish.

b. Willamette Falls:

Agreed-upon measures to address downstream salmonid passage at Willamette Falls are:

1. Remove 150 feet of flashboards at the Falls apex no later than October 1 until the controlled flow structure is installed.

2. Construct and operate a controlled flow structure at the Falls apex.

3. Assess the condition of adult salmonids that pass downstream through the controlled flow structure at the apex of the Falls and take measures identified as appropriate to ensure safe and timely passage of these fish.

4. Install avian predation deterrent devices in the lower horseshoe area of the Falls.

2. Upstream Passage

a. Willamette Falls Fish Ladder Responsibilities:

The present fish ladder at Willamette Falls was constructed by ODFW between 1968 and 1971, and major renovations were made in 1996/1997. While ODFW will continue to hold ownership of the ladder and remain responsible for operation and maintenance of the fish counting station, PGE will assume most of the fishway operations and maintenance (O&M) duties under this preferred alternative, as well as other measures described in this section.

PGE Duties and Measures at Willamette Falls Fish Ladder

Attraction Flow at Ladder Entrance #1

PGE will continue to coordinate scheduled outages of Unit 1 with ODFW, and will shut down all T.W. Sullivan turbine units should Unit 1 be inoperable for more than 24 hours during upstream anadromous migration until operation of Unit 1 can be restored. Continued powerhouse operation during Unit 1 shutdowns longer than 24 hours during upstream anadromous migration will require agency permission. PGE may choose at a future date to develop a new auxiliary water supply system for fish ladder entrance #1 in lieu of this shutdown requirement.

Hydraulic Conditions at Ladder Entrance #1

PGE will assess and fix ladder entrance #1 to meet NOAA Fisheries criteria for ladder entrances, entrance pools, and auxiliary water systems (AWS) for the range of tailwater levels expected during the adult fish passage season. These criteria include, but are not limited to:

1. The fishway entrance head (hydraulic drop shall be maintained between 1 to 1.5 feet).

2. The minimum entrance width shall be 4 feet and depth at least 6 feet.

3. Staff gages shall be installed to verify the entrance head.

4. Diffusers shall consist of non-corrosive, vertically-oriented flat-bar grates with a maximum 1-inch clear opening.

5. The maximum AWS diffuser velocity shall be less than 1 fps for vertical diffusers and 0.5 fps for horizontal diffusers.

PGE will work with ODFW and NOAA Fisheries to assess the extent of ladder entrance #1 non-compliance with these criteria by the end of 2003, and consult with the

FTC to determine the need and timelines for modifications to meet criteria based on this assessment.

Fish Ladder Operation and Maintenance (O&M)

PGE agrees to complete the backlog and annual O&M tasks described below to ensure continued and proper operation of the Willamette Falls fish ladder.

Backlog O&M Items—PGE agrees to complete the following Willamette Falls fish ladder backlog O&M items:

1. PGE will, to the extent feasible, perform the following projects within 6 months after the new license becomes final or by July 2005, whichever occurs first, taking into account appropriate in-water work periods.
   - Repair or replace the forebay level transducer.
   - Replace the weir support on the Obermeyer weir that has broken off.
   - Replace side seals on the Obermeyer weir and reattach restraining straps.
   - Install a new heater on the Obermeyer weir to prevent freezing on the end plates.

2. PGE will perform the following backlog projects as part of its annual O&M commitment (in addition to the items listed under subsection (2), below):
   - Grease the gate stem for auxiliary water discharge at ladder entrance #1 and gate stems for the two exit gates on the 67-foot deck.
   - Clean out the level sensor stilling wells at entrances #2 and #3.
   - Clean out debris at the auxiliary water channels at all three entrances.
   - Exercise all equipment each month as listed on the exercise log.

PGE will also be responsible to perform the following tasks; however, PGE and the Parties understand that an outside source of funding is being pursued to complete these backlog items. As an incentive to procure this outside funding, should it be procured, PGE will contribute $100,000 in matching funds to conduct Pacific lamprey research in the Willamette Basin.

- diffuser grate cleaning sand removal of debris from diffuser chambers
- fishway (leg #1) joint repairs

Annual O&M Items—Unless otherwise indicated, within 6 months after the new license becomes final, or July 2005, whichever occurs sooner, PGE agrees to implement the following regarding the Willamette Falls fish ladder annual O&M responsibilities:

1. PGE will assume, for any life of the new license, responsibility, including all labor and necessary equipment, to perform all annual O&M tasks directly associated with fish ladder operation.

2. PGE will assume debris removal responsibility at the fish ladder sluiceway adjacent to the Willamette Falls fish ladder. Debris removal will be consistent with an operational plan that takes into account debris loading in the river, PGE debris removal activities at T.W. Sullivan, and downstream migrant behavior, abundance and timing. The sluiceway will be opened to pass debris only between the hours of 10:00 a.m. and 2:00 p.m.

3. PGE will develop an operational plan for the above ladder measures in consultation with, and approval by, ODFW, NOAA Fisheries and U.S. Fish and Wildlife Service (USFWS). The plan will include appropriate tracking and reporting mechanisms to determine if specific changes are needed in the annual O&M plan to ensure proper fish ladder operation.

4. If feasible, PGE will extend the log boom in the T.W. Sullivan pre-forebay to reduce the amount of debris that accumulates at the fish ladder sluiceway. Any such extension would be completed within 1 year of the new license becoming final.

5. In addition to the measures identified above, PGE will fund or undertake measures to enable the Willamette Falls fish ladder to pass Pacific lamprey more effectively. Potential measures, subject to recommendation by the lamprey research expert and approved by appropriate fish agencies as applicable to the Willamette Falls Project, include, but are not necessarily limited to:

   - Partially covering the floor gratings with a solid contiguous plate.
   - Rounding off 90-degree corners at critical junctures in the ladder.
   - Installing an infrared light at the counting window instead of a bright light.
   - Modifying ladder entrances.
   - Other modifications identified through regional and/or national Pacific lamprey research.

3. Adult Pacific Lamprey

PGE will implement the following measures at Willamette Falls to assist in effective upstream passage of adult Pacific lamprey through the Project:

1. PGE will install a minimum of two lamprey passage ramps, and notch the flashboards when installed, to provide flows for lamprey below the dam and

Falls. Lamprey ramps will be designed and placed in consultation with the FTC. Efforts will focus on those areas where lamprey are known to congregate. These measures will be implemented within 6 months of any new license becoming final. The effectiveness of the ramps will be assessed during the Pacific lamprey research project, and continued implementation will be guided by the results of that research. PGE, in consultation with ODFW and USFWS, will conduct a preliminary assessment of lamprey ramp use in 2004. Modifications to the placement and design of ramps will be made if results of the monitoring program suggest that such actions are appropriate. If effective, additional ramps will be installed as needed to provide passage in areas where Pacific lamprey can be attracted.

2. PGE will undertake an effort to salvage stranded Pacific lamprey. Salvaged adult Pacific lamprey will be released above or below the Falls as directed by the agencies.

3. PGE will fund, to begin within 6 months of the new license becoming final, a research effort on Pacific lamprey passage and behavior consistent with Exhibit G, which contains the study-related portions outlined by the Non-Licensee Parties in their April 28, 2003, Adult Pacific Lamprey Passage Conceptual Proposal document. Development of this research effort plan will be initiated in 2004.

4. The research objectives and general approaches will be developed by an ad hoc committee of lamprey experts drawn from agencies, tribes, universities and private industry. This committee's recommendation will be reviewed by the FTC, which must reach agreement on the scope of research to be conducted. PGE will then contract with one or more research groups to conduct this work. Research will be conducted by a lamprey expert mutually acceptable to PGE and the FTC.

   - The research will evaluate Pacific lamprey passage at the Project and identify potential modifications to Project structures and the Willamette Falls fish ladder to improve passage.
   - If Pacific lamprey passage problems are identified, the research effort will assess the applicability and effectiveness of a lamprey capture-and-haul program at the Falls as a potential interim management tool to be used until permanent solutions to the passage problem are implemented.
   - The research will evaluate the effectiveness of the lamprey passage ramps at the Falls.
   - The research will consider appropriate testing of Pacific lamprey passage performance of the controlled-flow structure at the apex of the Falls, and

specifically evaluate passage effectiveness of lamprey passage features constructed within the controlled flow structure.

- The research will develop a reasonable Project structure-related performance goal for upstream passage of Pacific lamprey at Willamette Falls.

5. After the completion of the research study outlined above, and construction of the controlled flow structure at the apex of the Falls, PGE will, after consultation with the FTC (and subject to ODFW and USFWS approval), implement Pacific lamprey passage improvements to Project structures as required to meet any passage effectiveness target identified by the research program.

6. PGE will also test downstream passage of adult Pacific lamprey through the siphon bypass and controlled flow structure. Modifications to the structures will be made as needed to assure safe passage of Pacific lamprey.

4. Stranding

a. Background and Definition:

PGE will implement an Adult Salmonid and Adult Pacific Lamprey Stranding Plan at Willamette Falls. For the purposes of this plan, "stranding" is defined as a condition faced by an adult salmonid or Pacific lamprey when it cannot escape a dewatered or physically isolated area, and lacks sufficient flow to stay alive until egress can occur. A fish of these species in a dewatered or physically isolated area and showing signs of stress or mortality is considered "stranded." However, fish that are temporarily held in pools without stress and that are able to find egress are not considered "stranded" and should not be salvaged.

Some adult salmonids and adult Pacific lamprey get stranded in pools below Willamette Falls. These fish are attracted to naturally formed pools in the tailwater of the Falls or within the no longer active man-made fish ladder pools cut into the rock in the 1880's. When the flashboards are installed atop the dam, spill over the Falls is temporarily interrupted, causing stranding. Occasionally, changes in Project operations or changes in Willamette River flows will result in a change in the amount of spill over the Falls, which may cause stranding in these pools.

Efforts have been made to salvage and release adult salmonids stranded below Willamette Falls. These efforts have been successful in the old fishway channel cut into the rock at the Falls; however, stranding holes on the east side of the Falls are generally too deep or too obstructed to allow effective fish salvage operations. Recent permit requests to conduct adult salmonid salvage at the Falls have been denied by NOAA Fisheries due to concern that the fish would be stressed or killed in a salvage operation.

However, adult Pacific lamprey could be captured by hand or by dip net and live transported for release with less risk of mortality.

b. General Management Approach:

Fish that are temporarily held in pools without stress and that are able to find egress are not considered "stranded" and should not be salvaged. Salvage efforts are needed when fish have been stranded at least 48 hours (or less when they show signs of stress), and other means to ameliorate the stranding proven ineffective.

When ODFW or USFWS determines that fish are "stranded," the first approach will be to encourage fish to move downstream voluntarily by providing flow into the stranding pool or modifying Project operations as described by actions in Objective 1 (see below). If a pool or channel has become a chronic stranding problem to fish, PGE will implement actions to provide egress channels, as identified in Objective 2 (see below). Salvage operations, described in Objective 3 (see below), will occur as needed, but only if the actions in Objective 1 have been considered and found to be insufficient. Objective 4 (see below) includes actions that the Parties agree will reduce or eliminate stranding during closures of the Willamette Falls fish ladder.

Objective 1

Reduce or eliminate adult salmonid and Pacific lamprey stranding potential at Willamette Falls resulting from annual flashboard installation or other Project operations.

Action 1.1: PGE will operate the controlled flow structure to be constructed at the apex of Willamette Falls to minimize fish stranding below the Falls.

Action 1.2: PGE will notify Parties when flashboard installation is planned. The first notification will be approximately 2 weeks prior to the expected installation date, and the second notification 3–5 days prior to actual installation.

Action 1.3: Immediately after flashboard installation, PGE will reduce load at the plant to minimize the duration of time that there is a disruption of flow over the crest of the Falls and use the controlled-flow structure to minimize stranding. Normal plant operation will resume when flow through notches, installed under Action 1.4, has been established.

Action 1.4: During the flashboard installation and over the following 2 days, PGE will coordinate and conduct reconnaissance survey of adult salmonid stranding locations and severity at the Willamette Falls.

Adult Pacific lamprey congregations and movement will also be recorded.

Action 1.5: For Project operations that may result in stranding, such as startup after a powerhouse shutdown, PGE will also notify fish agencies 3–5 days prior to a planned event or within 24 hours of an unplanned event.

Action 1.6: PGE will provide flow to pools that either have fish in them, or could later have fish present. Appropriate flow at each location will be determined in consultation with the fish agencies, considering the nature of the pool, egress potential for fish, and the need to maintain head at the Project.

Objective 2

Provide egress channels at stranding pools by implementing structural changes to eliminate stranding pool blockages, including a specific problem identified at the "wet hole."

Action 2.1: PGE will accrue $5,000 annually to fund the creation of egress channels. This amount can be funded in advance if a specific modification project will cost more than the amount accrued. In the event an identified modification will exceed available funding, PGE and the FTC will consult on how to address the funding shortfall.

Action 2.2: The Parties will assess the Falls each spring with the intent of identifying stranding conditions that could be improved by physically modifying the topography below the Falls to provide egress from stranding pools.

Action 2.3: During the first year after a stranding situation is identified, the Parties will identify possible corrective actions and PGE will do the preparatory work (including permitting, cost estimating, channel modification assessments) for their modification the following year. The cost of this preparatory work is in addition to the annual commitment described in Action 2.1.

Action 2.4: The year following the identification of locations having egress blockage, PGE will resurvey these locations. To the extent funding is available under Action 2.1, and the egress blockage persists, PGE will take corrective actions in the next available in-water work period.

Action 2.5: In 2004, subject to obtaining necessary permits and the available in-water work period, PGE will modify the "wet hole" located at the northeastern base of the Falls to provide egress, at a cost of up to $80,000. This commitment is in addition to the annual commitment described in Action 2.1.

Objective 3

Provide actions to reduce or eliminate the stranding, including salvage operations if needed, of adult salmonids and Pacific lamprey stranded in pools or structures at the Falls as the result of the annual installation of the flashboards or other Project operations that may cause stranding.

Action 3.1: PGE will operate the controlled flow structure to be constructed at the apex of Willamette Falls so as to minimize the occurrence of fish stranding below the Falls.

Action 3.2: PGE will apply for all federal and State permits required to conduct the salvage of adult salmonids and Pacific lamprey stranded in pools or structures at the Falls.

Action 3.3: PGE and the fish agencies will determine salvage feasibility and needs when flashboards are installed each year.

Action 3.4: PGE and the fish agencies will also determine appropriate actions, including salvage needs, following flow fluctuations that might cause stranding, such as fluctuations due to powerhouse startup after a shutdown or significant river flow changes (greater than 10% in a 24-hr period). PGE will contact the fish agencies as described in Action 1.5 to coordinate this determination.

Action 3.5: For safety concerns, salvage for adult salmonids, if necessary, will only occur in the old fish ladder pools located on the west side of the Falls. PGE will release the fish in the tailwater of the Falls.

Action 3.6: When deemed necessary by the fish agencies, PGE will conduct adult Pacific lamprey salvage over a 2-day period determined by Actions 3.3 and 3.4. Lamprey will be released either above or below the Falls as determined by the fish agencies.

Action 3.7: PGE will document the number and species of fish salvaged. PGE will also note carcasses prior to salvage effort and document for the Parties any fish mortality associated with salvage efforts.

Objective 4

Reduce or eliminate stranding of adult salmonids and Pacific lamprey inside the Willamette Falls ladder during fish ladder closures.

Action 4.1: PGE will develop, in consultation with the ODFW and USFWS, an operation plan for the installation and removal of exclusion gratings at the Willamette Falls fish ladder.

Action 4.2: PGE will be responsible for the cost of constructing, maintaining, installing, and removing the exclusion grating for all four fish ladder entrances at the Willamette Falls fish ladder.

5. Recreational Enhancements

Recreation enhancement at Willamette Falls consists of two measures. One is a measure to facilitate implementation of a trail by the City of West Linn, and the other is providing interpretative and education opportunities.

a. West Linn Trail Enhancements:

PGE will work with the City of West Linn to grant easements on Project lands along the West Linn side of the Willamette River upstream of the Falls to facilitate the West Linn Park and Recreation Department's (WLPRD) trail development program. During the course of the licensing process, several trail segments desired by WLPRD have been identified and discussed with licensing participants. These trail segments are listed below for information only and are not being specifically proposed by the Applicants as part of the Applicants' alternative. Trail development received general stakeholder support as an appropriate enhancement to recreation. Any easement granted must be sufficiently conditioned so as to protect sensitive resources and the public, as well as Project and paper mill operations

b. Willamette River Trail Segment:

This approximately 2,700-foot-long trail segment would begin at Willamette Park and run along the densely vegetated bank of the Willamette River to the downstream end of the BHPC lagoon at Fourth Street.

c. Willamette River to Willamette Drive Trail Segment:

This approximately 6,500-foot-long trail segment would begin at the downstream end of the BHPC lagoon near Fourth Street and traverse a heavily wooded parcel to the abandoned Sixth Avenue trolley line right-of-way, cross the WLPC warehouse 3/lagoon access road, and terminate at the potential Willamette Drive Viewpoint site, which is

located adjacent to the PGE substation. The trail could be continued further downstream in a separate action.

d. Tualatin River Trail Segment:

This trail segment would begin Willamette Park, extending upstream along the bank of the Tualatin River until it exits the Project boundary. This 3,200-foot-long trail could be continued further upstream in a separate action.

6. Interpretive and Educational Enhancements

In each of the following interpretation and enhancement measure opportunities, the Applicants would assist and/or help fund local entities in the development of interpretive and educational opportunities related to the Willamette Falls Project, hydroelectric power, fish passage, and/or the Native American significance of Willamette Falls.

a. Willamette Falls Cultural and Heritage Committee (WFCHC):

The Applicants would provide funding or other assistance to the WFCHC in developing interpretive and/or educational opportunities. These opportunities could include assisting the WFCHC in obtaining space near the Project area for museum use and/or helping to plan for or develop interpretive exhibits.

b. Museum of the Oregon Territory:

The Applicants would assist the Museum of the Oregon Territory in developing interpretive or educational opportunities. These opportunities could include assisting the museum in developing interpretive exhibits. Any interpretive and education proposals related to Tribal interests would be developed in consultation with pertinent Tribes.

7. Cultural Resource Measures

The Applicants will continue to consult with participants, responsible agencies, and Indian tribes to:

- Complete the Determination of Eligibility (DOE) that was filed for the Willamette Falls Industrial Complex, of which the Willamette Falls Hydroelectric Project is included and implement applicable actions
- Develop a Historical Properties Management Plan (HPMP).

C. No-Action Alternative

Under the no-action alternative, the Project would continue to operate under the terms and conditions of the existing license, any ongoing effects of the Project would

continue, and no new environmental protection, mitigation, or enhancement measures would be implemented. This alternative is used only to establish the baseline environmental conditions for comparison with other alternatives.

D. Alternatives Considered but Eliminated from Detailed Study

1. Federal Takeover

Federal takeover of the Project and issuing a nonpower license was also considered but eliminated from further analysis. A nonpower license is a temporary license that the Commission will terminate whenever it determines that another governmental agency will assume regulatory authority and supervision over the lands and facilities covered by the nonpower license. In this case, no agency has suggested its willingness or ability to do so. No party has sought a nonpower license, therefore, Federal takeover is eliminated from detailed study.

2. Project Decommissioning

Project decommissioning could be accomplished with or without dam removal. Either alternative would involve denial of the license application and surrender or termination of the existing license with appropriate conditions. Under a dam removal scenario, project retirement would be accomplished by removing the project's dam and related project works. The reservoir would be eliminated, and upstream riverine conditions would gradually re-establish. A dam retention scenario would involve retaining the dam and reservoir, while disabling or removing equipment used to generate electricity. A dam retention scenario would require the Commission to identify another government agency willing and able to assume regulatory control of the remaining facilities. Under either decommissioning scenario, the energy generated by the project would be lost. The energy lost would have to be replaced by an alternative energy source with its associated environmental effects.

Decommissioning of the T.W. Sullivan powerhouse and associated structures was considered at the request of the licensing participants, and a preliminary evaluation was conducted. This evaluation is contained within the Decommissioning Report that was completed and distributed during the relicensing process. It was concluded that decomissioning should be eliminated from further analysis.

IV. CONSULTATION AND COMPLIANCE

A. Consultation

The Commission's regulations (18 CFR Section 4.38 and 16.8) require that Applicants consult with appropriate resource agencies and other entities before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act, the Endangered Species Act, the National Historic Preservation Act, and other federal statutes. Pre-filing consultation must be completed and documented according to the Commission's regulations.

In 1997, PGE and BHPC began discussion with resource agencies and potential relicensing participants to develop a relicensing process for the Willamette Falls Project. Support for an alternative licensing process developed. The Applicants submitted a request to FERC on September 1, 1998, to conduct an alternative relicensing process; specifically, an Applicant Prepared Environmental Assessment (APEA). FERC reviewed and approved the APEA process on December 10, 1998.

1. Scoping

Scoping of issues began in February 1999. On December 14, 1999, a Scoping Document (SD1) was released that described environmental issues to be addressed during the relicensing process.

Public scoping meetings were conducted on January 20, 2000. Parties unable to attend the scoping meetings were also invited to submit written comments and information to FERC and the Applicants. Written comment submittals on SD1 are part of the public record and are included in Scoping Document 2 (SD2) released June 28, 2001.

Scoping comments focused on five core areas: 1) modifications at T.W. Sullivan and BHPC powerhouses, 2) water quality, 3) fish passage at T.W. Sullivan and BHPC Developments, 4) potential Falls mortality and predation on downstream migrants, and 5) Project effects on listed species.

The main issues identified during the scoping process regarding fish passage at the Project include: providing safe downstream fish passage through the T.W. Sullivan Development and through the BHPC Development; lessening fall back rates of upstream fish migrants after passing through the fishway; improving downstream fish migrant routes to allow safer passage past Willamette Falls; reducing delay or injury associated with locating fish ladder entrances; reducing predation risks during upstream fish passage past the project; providing suitable attraction flows at the fish ladder entrances; and reducing false attraction to turbine discharges.

On June 28, 2001, Scoping Document 2 (SD2) was released. SD2 incorporated oral and written comments provided by the public and the relicensing participants on SD1. It amended the preliminary list of resource issues, presented the status of studies that were completed and underway for 2001, and included the Applicants' responses to comments. SD2 provided the basis for the issues and alternatives addressed in this PDEA.

The following entities filed written scoping comments on the Willamette Falls Project.

Commenting Entity	Date of Letter
Oregon Water Resources Department	March 15, 2000
ODFW	March 15, 2000
American Rivers (AR/TU/OT/NFS) (SD1)	March 20, 2000
Hydroelectric Application Review Team (HART) (WRD/ODEQ/ODFW/DOGAMI) (SD1)	March 21, 2000
Oregon Department of Environmental Quality (ODEQ)	March 21, 2000
NOAA Fisheries[1] (SD1)	March 22, 2000
USFWS (SD1)	March 22, 2000
NOAA Fisheries/USFWS (SD 1)	March 24, 2000
USFWS (SD2)	August 27, 2001
ODEQ (SD2)	August 30, 2001
NGO Technical Representative (SD2)	August 31, 2001

2. Interventions

On March 31, 2003, the Commission issued a notice accepting PGE's application to relicence Willamette Falls Project. This notice set a 60-day period during which interventions and comments, as well as terms, conditions, prescriptions, and recommendations could be filed. The following entities filed comments, terms conditions, prescriptions, or recommendations. An (I) indicates the entity also filed a motion to intervene, none of which are in opposition to relicensing the project.

Comment Entity	Date of Letter
The Confederated Tribes of the Grande Ronde (I)	April 23, 2003
U.S. Department of the Interior (I)	May 20, 2003

[1] Formerly National Marine Fisheries Service, or NMFS.

NOAA Fisheries (I)	May 28, 2003
Oregon Hydroelectric Application Review Team (I) (Water Resources Department, Dept of Environmental Quality, Division of State Lands, Dept of Fish & Wildlife)	May 29, 2003
Confederated Tribes of Siletz Indians of Oregon (I)	May 29, 2003
Confederated Tribes of the Warm Springs Reservation of Oregon (I)	May 30, 2003
Columbia River Inter-Tribal Fish Commission (I)	May 30, 2003
American Rivers, Oregon Trout, Trout Unlimited, Native Fish Society (I)	May 30, 2003

3. Draft Environmental Assessment

On January 23, 2004, the Commission issued a DEA for the project. The following entities filed comments:

Comment Entity	Date of Letter
Oregon Hydroelectric Application Review Team (Water Resources Department, Dept. of Environmental Quality, Dept. of State Lands, Dept. of Fish & Wildlife)	March 1, 2004
U.S. Department of the Interior (U.S. Fish and Wildlife Service)	March 3, 2004
American Rivers, Oregon Trout, Trout Unlimited, Native Fish Society	March 4, 2004
Portland General Electric	March 5, 2004
NOAA Fisheries	March 11, 2004

Appendix A contains the comments and our responses. This FEA includes the changes as a result of our consideration of these comments.

B. Compliance

1. Water Quality Certification

The Applicants filed an application for Water Quality Certification (WQC) for the Willamette Falls Project on December 19, 2002, with the Oregon Department of Environmental Quality (ODEQ). ODEQ replied that the 401 application was not complete and requested additional information. On September 3, 2003, ODEQ denied

without prejudice PGE's WQC. PGE refiled its revised 401 WQC application on November 21, 2003.

2. Section 18 Fishway Prescriptions

Section 18 of the FPA states that the Commission shall require construction, maintenance and operation by a licensee of such fishways as the Secretaries of the Department of Commerce (Commerce) and the Department of the Interior (Interior) may prescribe.

Commerce and Interior, by letters dated May 28, 2003, filed Preliminary Section 18 Fishway Prescriptions for the safe and timely upstream and downstream passage of fish including prescriptions for physical structures, facilities, project operations and measures to effectively pass fish. The preliminary prescriptions were developed cooperatively in consultation with PGE. The prescriptions for upstream, downstream passage and fish protection are structured in protection, mitigation and enhancement measures to be implemented by PGE in a "Tiered Plan." The final proposed fish passage measures for the Project are contained in the Settlement Agreement filed by PGE on February 2, 2004, and described in the Environmental Analysis – Fish Resources Section of this FEA.

In a letter filed March 3, 2004, the USFWS informed the Commission that their modified fishway prescriptions are consistent with the Settlement Agreement filed on February 2, 2004. In a letter filed May 7, 2004, NOAA Fisheries' modified Section 18 Fishway Prescriptions include the Settlement Agreement Proposed License Articles 2 through 6; Articles 8 through 10; and Articles12 and 13. In addition, NOAA Fisheries requested reservation of authority to prescribe additional or modified fishways during the term of the license.

The USFWS and NOAA Fisheries recommend that the Commission adopt the conditions in the Settlement Agreement, which include their final Section 18 Fishway Prescriptions.

3. Endangered Species Act

Under Section 7(a)(2) of the Endangered Species Act (ESA), federal agencies are required to consult with the USFWS and/or the NOAA Fisheries if they contemplate performance of an action that may jeopardize a listed species or its critical habitat. FERC designated PGE as the non-federal representative for purposes of informal ESA consultation with NOAA Fisheries, and USFWS.

PGE prepared and filed with the Commission a supplemental Biological Evaluation/Assessment (BA) of the project effects on federally listed species (PGE 2003). Staff reviewed the BA and concurred with its analysis and conclusions of the

project effects on federally listed species. We adopted the BA as the Commission's Biological Assessment and requested formal consultation under the ESA with the USFWS and NOAA Fisheries in letters issued February 4, 2004. In a letter filed March 12, 2004, NOAA Fisheries informed the Commission that until the FERC determines whether or not to adopt the Settlement Agreement in a final or supplemental EA, they would wait to respond to our request for consultation. In a letter filed June 4, 2004, the USFW concurred with the staff finding that the proposed action is not likely to adversely affect bald eagles.

4. Fish & Wildlife Recommendations

Under Section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law.

PGE continued to negotiate with the fish and wildlife agencies following the filing of their license application and issuance of the DEA. On February 2, 2004, PGE filed a Settlement Agreement with Proposed License Articles. The USFWS, NOAA Fisheries, and ODFW recommend that the Commission adopt the conditions in the Settlement Agreement, which would resolve all of the 10(j) issues for the project.

5. Coastal Zone Management Act

The Project is not located within the Columbia River Basin coastal zone and is not anticipated to have any negative impacts on the coastal zone.

6. Oregon State Land Board

The Applicant will work with the Oregon Department of State Lands (ODSL), the division that manages publicly owned land on behalf of the State Land Board, to determine which project related facilities occupying state-owned land along the Willamette River, if any, are subject to lease requirements as referenced in an ODSL letter to PGE dated March 11, 2002 and comment letter filed with the Commission on May 22, 2003. If such lands are identified, Applicants will enter into the required lease agreement with ODSL consistent with OAR 141-087-0001 through 141-087-0050 that governs the issuance of leases and easements for hydroelectric projects on lands managed by the Oregon State Land Board.

7. *National Historic Preservation Act*

Section 106 of the National Historic Preservation Act requires that federal agencies consider the effects of their actions, and actions that they may assist, permit, or

license, on historical properties, and those agencies give the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such actions.

Section 106 consultation was initiated by FERC in a letter dated May 26, 2000.

In addition to the regularly scheduled licensing meetings that were held as part of the alternative licensing process, numerous telephone conferences and historic resource specific meetings were held with Tribes and resource agencies to discuss project effects on historic resources.

PGE filed with the Commission a Final Historic Properties Management Plan with recommended measures to resolve potential adverse effects to historic properties. The Plan and a Programmatic Agreement will be submitted to the Advisory Council and the Oregon State Historic Preservation Officer for review and concurrence.

V. ENVIRONMENTAL ANALYSIS

A. General Description of the River Basin

The Willamette River originates in the High Cascades, flows north through the Western Cascades and Willamette Valley, and discharges into the Columbia River in northwest Oregon (Figure 1). The Coast Range form the western boundary of the Willamette Basin, with most peaks extending from 1,500-2000 ft to over 3,000 ft (Uhrich and Wentz 1999). The Western and High Cascade ranges on the east side of the Willamette Basin are much higher, extending from 5,000-6,000 ft to higher than 10,000 ft in the High Cascade Range. The climate of the Willamette Basin is affected by its proximity to the Pacific Ocean. Prevailing westerly winds produce cool, wet winters and warm, dry summers (Uhrich and Wentz 1999). Precipitation at the Project site averages about 43 in/yr, with most occurring between November and March. Precipitation in the Coast Range adjacent to the Willamette River can be as high as 150 in/yr. At higher elevations in the Cascade Range (i.e., > 4000 ft), most of the precipitation falls as snow.

The Willamette River flows north approximately 309 mi (Kammerer 1990), entering into the Columbia River at Portland, Oregon. It has a drainage area of 11,500 mi^2 (Uhrich and Wentz 1999). Perennial streams dominate the northern portion of the Basin with intermittent streams more common in the south (Omernick and Gallant 1986). Tributary densities are greatest in the mountains, with as many as 2-3 miles of perennial stream per square mile in the Coast Range. As the river flows into the Willamette Valley, it meanders through a flat lowland and is bounded by steep banks of unconsolidated sediments. Near Willamette Falls (RM 26.5), the river channel straightens and the relief of the surrounding landscape increases. The Falls is a natural feature with waters cascading over a horseshoe-shaped rock formation. The river drops up to 40 ft at the Falls and then flows through the Portland Basin to the Columbia River. The terrain of the Portland Basin is characterized by rolling topography between elevations of 100-250 ft. The Willamette River Basin includes 13 major tributaries, 12 of which occur upstream of the Project site. The Clackamas River is the only tributary that discharges downstream of Willamette Falls.

Land use within the Basin ranges from National Forest land to industrial and urban developed land. Forested areas, found in the Coastal Range and Cascade Mountains, comprise about 60-70% of the Willamette Basin, while agricultural lands are the next most abundant, comprising about 17-22% of the basin (Uhrich and Wentz 1999). Agriculture occurs primarily in the low-lying Willamette Valley between the two mountain ranges. Urban development makes up approximately 6% of total basin lands, with the majority of cities located adjacent to the river (Uhrich and Wentz 1999).

The mainstem Willamette River has undergone significant changes from its pre-development condition. Historically, the river was a highly braided channel that meandered through broad, low gradient riparian woodland and wetland habitat (Sedell

and Froggatt 1984). In contrast, the present mainstem consists of a single channel. Extensive channelization throughout portions of the Willamette River basin has reduced the river length in those sections by 50% (Benner and Sedell 1996). Habitat changes related to navigational improvements on the river include the removal of large woody debris, channel dredging, the construction of "cut-off" dams, and installation of rip-rap along the banks, and dikes (PGE and BHPC 1998a).

The Willamette River has been used for water supply and hydropower production for over 100 years. The Project has the only dam on the mainstem Willamette River; however, the USACE operates thirteen reservoirs in tributaries to the Willamette River to regulate discharge. Six reservoirs have been developed in the middle and coast forks of the Willamette River. Seven reservoirs are located on other major tributaries to the Willamette River, including the McKenzie, Long Tom, and Santiam Rivers. The Willamette River is a source for irrigation and municipal water supply and provides recreational fishing, boating, and wildlife viewing opportunities (Stillwater Sciences 2001).

While there has been considerable modification and development along much of the shoreline of the mainstem Willamette River, the mainstem waters of the Willamette River remain largely undeveloped, except in the vicinity of the Project. The Willamette Falls Project is situated at Willamette Falls (RM 26.5), approximately 10 mi upstream of Portland. The Project is a run-of-river facility with no usable storage capacity (i.e. water is not stored above the dam in the project pool area for subsequent release) and is operated only for power generation. Navigation locks allowing commercial and recreational boat traffic past Willamette Falls are operated by the USACE. Fishing and boating are popular activities on the Willamette River near the Project.

Hydraulic regimes in the Willamette River Basin are characterized by low flows from July through September and high flows in the winter. Peak flows and natural flood events in the Willamette River have decreased as a consequence of USACE dam and reservoir construction high up in the watershed and channel modification (Stillwater Sciences 2001), and minimum flows have increased (PGE and BHPC 1998a). Hydraulic regimes and sediment input likely have been altered by high road densities in urban areas within the basin, which can be greater than 6.2 mi/mi^2 (BLM 1998).

A diverse fish fauna occurs in the vicinity of the Project. The anadromous fish resources from the Willamette Basin represent some of the largest runs in the lower Columbia River (Letter from K. Kirkendall, NOAA Fisheries, personal communication, November 16, 2001). Many anadromous species use the river as a migratory corridor, including salmonids, lamprey, and American shad. In total, more than a million hatchery and wild migratory juvenile and adult fishes pass through the Project area annually. Special status salmonids in the Willamette River Basin include spring run chinook salmon, coho salmon, winter steelhead, bull trout, and coastal cutthroat trout. Oregon chub are a federally listed resident species that have been documented well upstream of

the Project, but do not inhabit waters near Willamette Falls. Hatchery-origin fish have been stocked widely in the Willamette River to supplement existing natural populations. It is speculated that as much as 95% of the spring chinook salmon and 25% of winter steelhead adult runs are composed of hatchery-reared fish (Foster 2001). In addition, although some natural reproduction occurs, the upper Willamette populations of coho salmon, fall chinook salmon, and summer steelhead were derived from introduced hatchery stocks.

B. Cumulative Effects

In accordance with the Council on Environmental Quality's regulations for the National Environmental Policy Act, an action may cause cumulative impacts on the environment if it overlaps with the impacts from any other past, present, and reasonably foreseeable future actions. Thus individually minor impacts may collectively result in significant cumulative impacts. This accumulation of impacts may include hydropower and other land and water development activities. The existing environmental condition demonstrates the effects of past and present actions and provides the context for evaluating the cumulative impacts associated with future actions.

1. Geographic Scope

We reviewed the Project's potential to contribute to beneficial and/or adverse cumulative impacts, either alone or in conjunction with other actions in the Willamette River and determined that fisheries resources and water quality have potential to be cumulatively affected by Project operations. The potential for fisheries resources is specific to impacts on ESA- listed steelhead and spring chinook salmon. These fish populations are subject to direct impacts associated with upstream passage barriers, industrial effluents, entrainment, as well as genetic and ecological impacts associated with hatchery releases in the basin. In addition, habitat alteration from other hydroelectric developments, irrigation and agricultural runoff, urban development, and domestic water treatment cumulatively affect these populations in the Willamette Basin. These salmonid fishes utilize the entire river basin from spawning grounds in tributaries to the mouth of the river. The potential actions affecting the fish also are spread throughout the basin. Thus, the geographic scope of cumulative effects has been determined to be the entire Willamette River Basin.

Water quality also has the potential to be cumulatively affected in the Project area as a result of urban, industrial, and agricultural runoff as well as domestic water treatment. Water quality monitoring performed to date has not shown the Project having any distinct or measurable effect on water quality. However, the waters of the Willamette River from the mouth to the Yamhill River (approximately RM 60) are 303 (d) listed for bacteria (fecal coliform), biological criteria (fish skeletal deformities), temperature, and toxics (mercury in fish tissue). In the Water Resources Section (Section

V.C.), site-specific and cumulative impacts are discussed as they exist throughout the Willamette Falls Project area.

2. Temporal Scope

The temporal scope of the cumulative effect analysis includes a discussion of the past, present and reasonably foreseeable future actions and their affects on fish and water resources. Based on the term of the proposed license, the FEA will consider 30-50 years into the future, concentrating on fish and water resources. Due to the urban location and highly developed area around the Willamette Falls Project, anticipated impacts are associated with increased urbanization, water quality and habitat alteration, Willamette River Total Maximum Daily Load (TMDL) and local comprehensive plans.

C. Proposed Action and Action Alternatives

1. Geological Resources

a. Affected Environment:

Physiography

Glacially deposited sedimentary material covering the valley has been deposited along most waterways, whose profiles are defined by the underlying bedrock geology (Normandeau Associates, Inc. 2001a). The United States Geological Service (USGS) (Rickert *et al.* 1977 in Normandeau Associates, Inc. 2001a) subdivides the profile of the Willamette River into three sections: the Upstream Reach, the Newberg Pool and the Tidal Reach. The Upstream Reach extends from the confluence of the Coast Fork and the Middle Fork of the Willamette River to Newberg. The Newberg Pool extends from above Newberg (RM 52.1) to the Falls (RM 26.5), while the Tidal Reach extends from the Falls to the confluence with the Columbia River. The Falls is a topographic break between the Newberg Pool and the Tidal Reach and represents a topographic control point (base level) for the Newberg Pool (Normandeau Associates, Inc. 2001a).

Upstream of Newberg, the Willamette River meanders through a flat lowland and is bounded by steep banks of unconsolidated sediments. The unconsolidated nature of the bank material in this portion of the river has allowed for its lateral migration, forming cutoff meanders and oxbows (Hoerauf 1970 and Normandeau Associates, Inc. 2001a). Downstream of Newberg, as the river approaches the Falls, its channel straightens and the relief of the surrounding landscape increases. The Falls are formed where the river cuts across a resistant bedrock outcropping. Above the Falls, the river flows through a canyon defined by forested hills that rise 400-500 ft on the east and 600-700 ft on the west. The adjacent Tualatin Mountains continue downstream to the northwest along the west side of and parallel with the Willamette River. The Willamette River drops about 30 to 40 ft at the Falls, with the height varying seasonally. Winter and early spring

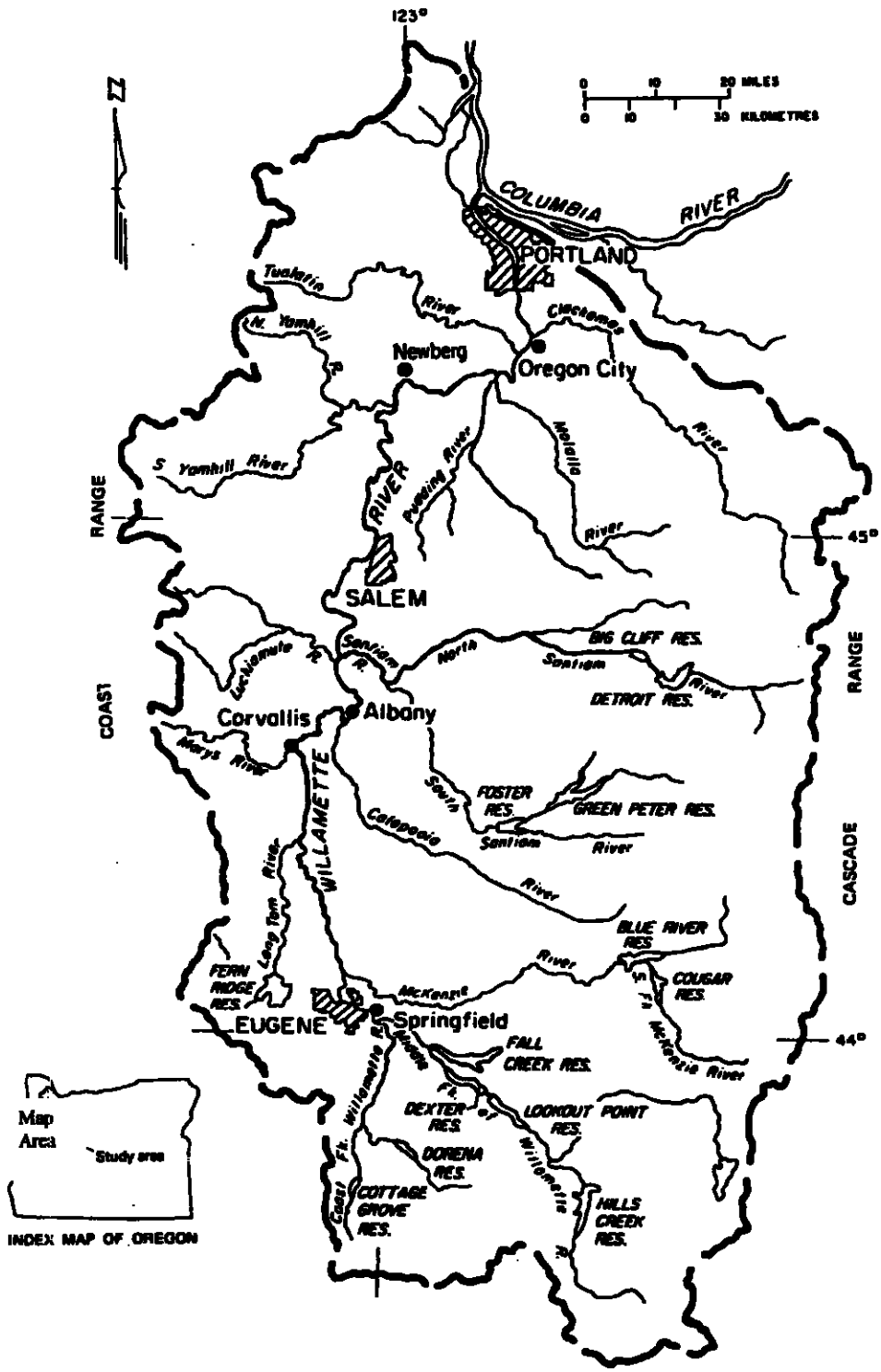

Figure 1. Map of major tributaries and reservoirs in the upper Willamette River.

flooding can overwhelm the Falls, with major floods transforming them into rapids. In the late summer when water levels at the base of the Falls are lowest, the Falls might be as high as 45 ft (AINW 2001). Numerous exposures of bedrock are observed along the banks of the Falls and underlying the channel. A narrow bench or terrace along the river characterizes the Project site, with steep bluffs on the east that rise about 80-100 ft. The western terrace is about 1,500 ft at its widest. At the top of the eastern bluff is a second terrace that extends to the southeast about 3,000-4,000 ft before rising to a third terrace. The west side of the Falls has a similar terrace at the foot of a steep slope into the Tualatin Mountains. The west side terrace is only about 500 ft wide. There are two submerged islands immediately upstream of the Falls, Abernethy Island on the east and Moore's Island on the west side.

Downstream of the Falls, the Willamette River enters a broad valley of the Columbia River, sometimes designated as the Portland Basin. The terrain of the Portland Basin is characterized by rolling topography at elevations of 100 to 250 ft. The Willamette is the last major river to empty into the Columbia before it reaches the Pacific Ocean, entering it about 90 mi from the ocean.

Within a short distance of the Falls, the Willamette meets two major tributaries. The Tualatin River, emptying into the Willamette about 2 mi above the Falls, drains the eastern slopes of the Coast Range and flows through an extensive alluvial valley northwest of the Falls. About 1 mi below the Falls, the Clackamas River enters the Willamette River from the east. The Clackamas flows north and west through the western slopes of the Cascade Range.

Geology

Regional geologic and hydrogeologic studies covering the Project area include geologic mapping by Treasher (1942), Trimble (1957 and 1963), Madin (1990) and Swanson *et al.* (1993). The major geologic units in the Project area, from oldest to youngest, are the Columbia River Basalt Group, lower and upper Troutdale Formation, Boring Lava, Pleistocene Flood Deposits and Quaternary Alluvium.

Soils

Land use in the Project area is primarily industrial with limited dependence upon soil resources. Soils on the terraces on both sides of the Willamette River at the Falls consist of fine sandy loam of the Newberg series. Soils on the steep basalt slopes consist of stony loam of the Witzel series (Gerig 1985 in Oetting 2001). The north bank of the Tualatin River has Cloquato silt loam, with Woodburn silt loam in the steep rocky area near Weiss Bridge (Gerig 1985 in Oetting 2001). Newberg and Cloquato soils are deep and well- to excessively-drained, formed in mixed alluvium on floodplains. Witzel soils are shallow and well drained, formed in colluvium derived from basalt. The Woodburn

silt loam is a deep, well-drained soil found on valley terraces and formed in stratified glaciolacustrine sediments.

Geologic Hazards in the Project Area

Seismicity

Historically, the Portland Basin is only moderately seismically active. The largest regional earthquake was the magnitude 7.1 Olympia earthquake in 1949, about 112 mi north of the Falls. The Portland area was shaken with Modified Mercalli Intensity of VI by this event. The largest recorded intensities in Portland occurred in 1877 and 1962. Both of these events had Modified Mercalli Intensity of VII. Other lesser earthquakes of intensity VI occurred in 1892, 1941, and 1953. The 1962 earthquake was the largest instrumentally recorded event in the Portland area, with a magnitude of approximately 5.2. It was centered 8-mi east of the Portland West Hills and about 14 mi north of Willamette Falls and occurred along an unidentified fault (Yelin and Patton 1991).

The understanding of earthquake hazard in the Pacific Northwest has increased significantly in the last 15 years. Geologic studies have increased the number of known crustal fault sources and the occurrence of great earthquakes offshore has been confirmed. The studies have resulted in increased awareness by owners of major infrastructure. PGE commissioned Golder and Associates in 2001/2002 to update the seismic hazards evaluations for all PGE sites including Willamette Falls. This evaluation (dated July 2, 2002) identified significant hazards for two types of earthquakes associated with the Cascadia Subduction Zone and earthquakes associated with 9 potentially active faults within 31 km of Willamette Falls. The closest of these faults was the Bolten Fault that is approximately 1 km from the falls. This fault is listed as having as having a maximum credible earthquake of Mw 6.1 which equates to a maximum peak ground acceleration of (median value) of 0.57g's at the Willamette Falls site. At the time of this writing, the report is under review by the FERC Division of Dam Safety and Inspections, and the cap at the falls is being analyzed for seismic stability.

Volcanism

Mount St. Helens is the closest active volcano to the Project site, at a distance of approximately 40 mi. It experienced a cataclysmic eruption in 1980. No significant damage related to the eruption was experienced in the Portland area. Mount Hood is a potentially active volcano 45 mi from Portland. It last erupted between 170 and 220 years ago, when dacitic lava domes, and pyroclastic flows and mudflows were produced without major explosive eruptions (Scott *et al.* 1997).

Landslides and Erosion

On June 27, 2000, a reconnaissance level field survey of the Willamette River was completed to assess channel conditions and identify areas of sedimentation and erosion from the Falls upstream to Wilsonville (Normandeau Associates, Inc. 2001a). No significant erosion sites or landslides were identified during the field survey.

b. Environmental Impacts and Recommendations:

There are no proposed measures specifically related to geologic resources. Several of the proposed measures; however, have the potential to affect geological resources. These potential impacts are described in the following paragraphs.

Issue Statement

Several proposed downstream fish passage measures have the potential to impact geologic and soils resources.

T.W. Sullivan Forebay, Powerhouse, and Tailrace Modifications

Modifying the siphon to create a bypass spillway, modifying the tailrace discharges from Units 12 and 13, and modifying the Unit 13 bypass system outfall chute would require some rock excavation to prepare the foundations for construction and to accommodate added structures. The volume of material to be excavated has not been estimated but is not expected to impact geology or soils.

Modifications to Dam

Minor rock excavation and rock bolting likely would be required to prepare the foundations for construction of a flow slot and associated control structure. The construction and operation of the dam notch options would not affect the geology or soils resources.

West Linn Trail Development Easement

Entering into an easement agreement for trail development with the City of West Linn Parks and Recreation Department will not affect the geology and/or soils resources in the project area. Provisions of the easement will ensure that no adverse conditions are created as a result of the trail construction or its use.

Conclusions

No significant impacts on geologic and soils resources are anticipated. An erosion and sediment control plan (ESCP) would be developed that outlines measures for

minimizing erosion and containing sediment during the construction of the various alternatives to ensure minimal construction impacts.

c. Unavoidable Adverse Impacts:

No unavoidable adverse impacts were identified.

2. Water Resources

a. Affected Environment:

Thirteen major tributaries discharge into the main stem of the Willamette River (figure 1). Twelve tributaries are upstream of the Project and the Clackamas River is downstream of the Project. The largest tributaries, in terms of discharge,[2] are on the Cascade (eastern) side of the Willamette River Basin (table 1). The three major tributaries on the eastern side of the basin are the McKenzie River and the north and south forks of the Santiam River. Flows over the Falls and water levels behind the Falls have been altered by the Project and may affect water quality in the Willamette River.

The impoundment upstream of Willamette Falls varies in size, but reaches 25 to 30 miles upstream of the Falls, with an estimated surface area of about 2,248 acres. The pool elevation varies with river flows, but is maintained at a minimum elevation of approximately 54 ft mean sea level (MSL) using 2-foot high seasonal flashboards installed at the dam. The pool level drops below 54 ft MSL during periods of low flow prior to, or sometimes after, annual installation of flashboards. Flashboard installation takes place each year typically in the beginning of July. River elevation is maintained, in part, to accommodate multiple water users, including the Oregon Department of Fish and Wildlife (ODFW) fish ladder, the Canby Ferry, and the U.S. Army Corps of Engineers (Corps) locks. Water levels in the tailrace are tidally influenced and change on the order of 3 to 4 ft twice each day.

Water Quantity

Annual Runoff Patterns

The Willamette River Basin is characterized by five ecoregions: the Willamette Valley plains, the Willamette Valley foothills, the Coast Mountains, the Western Cascades, and the High Cascades (Uhrich and Wentz 1999). The High and Western Cascades together comprise approximately 50 percent of the basin. The Coast Mountains on the west side of the Willamette River make up approximately 8 percent of the basin. These three ecoregions strongly influence annual runoff in the basin, with as much as 200 inches of precipitation falling annually near the crests of these mountain ranges (Uhrich and Wentz 1999).

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[2] Streamflows in cubic feet per second (cfs).

The weather pattern in the Willamette Basin is characterized by cool, wet winters and warm, dry summers. The average annual precipitation in the basin over a 30-yr period (1961 to1990) was 62 inches, as rain in lower elevations and as snow above the 4000-ft level (Uhrich and Wentz 1999). The average annual precipitation at the Project is 43 inches, most (approximately 85 percent) falling from October to March (Uhrich and Wentz 1999). Snowmelt occurs from April to June, providing additional flows to the basin. Limited rain (approximately 5percent) falls during July to August (Uhrich and Wentz 1999). Streamflow closely follows precipitation patterns, with 60 to 85 percent of runoff occurring from October to March and less than 10 percent in July and August (Uhrich and Wentz 1999).

Table 1. USGS stream flow gauging stations in the Willamette Basin.

Site Number	Name (gage elevation – feet above sea level)	Drainage Area (ac)	Period of Record (water years)	Mean annual streamflow (cfs/mi^2)
14147500	North Fork of Middle Fork Willamette River near Oakridge (1,029.60)	0.06	1940-92	3.2
14152000	Middle Fork Willamette River at Jasper (513.45)	0.33	1953-92	3.1
14152500	Coast Fork Willamette River at London (852.58)	0.12	1940-87	2.8
14159200	South Fork McKenzie River above Cougar Lake near Rainbow (1,709.51)	0.04	1958-87	4.0
14166000	Willamette River at Harrisburg (288.39)	0.85	1945-92	3.5
14166500	Long Tom River near Noti (389.05)	0.02	1940-91	2.6
14171000	Marys River near Philomath (224.01)	0.04	1941-85	2.9
14172000	Calapooia River at Holley (527.58)	0.03	1940-90	4.1
14174000	Willamette River at Albany (167.18)	1.20	1940-92	3.0
14185000	South Santiam River below Cascadia (759.88)	0.04	1940-92	4.7
14190500	Luckiamute River near Suver (171.92)	0.06	1941-91	3.6
14191000	**Willamette River at Salem (106.14)**[1]	1.80	1940-92	3.3
14192500	South Yamhill River near Willamina (235.55)	0.03	1940-91	4.6
14198500	Molalla River above Pine Creek near Wilhoit (791.35)	0.02	1940-92	5.5
14203500	Tualatin River near Dilley (147.57)	0.03	1941-91	3.1
14209500	Clackamas River above Three Lynx	0.12	1940-92	4.2

Site Number	Name (gage elevation – feet above sea level)	Drainage Area (ac)	Period of Record (water years)	Mean annual streamflow (cfs/mi^2)
	Creek (1,091.69)			
14211720	**Willamette River at Portland (1.55)**[1]	2.77	1973-92	2.9

[1]Willamette Falls is located between these two gage locations. Salem is located at river mile (RM) 85 and Willamette Falls is located at RM 26.5.

Historically, the Willamette River was subject to regular, severe flooding with rain-on-snow events. The past removal of woody debris upstream of the Project, construction of numerous dams and reservoirs in the upper basin, and straightening the river channel through urban and agricultural areas likely influenced the present occurrence and duration of flooding in the Willamette River Basin.

The Willamette River has the 13th largest discharge of all rivers in the United States (Uhrich and Wentz 1999), with flows dependent on surface and groundwater interactions (USGS 1998). During the period 1973 to 1987, the annual mean monthly flow was 33,300 cfs (PGE and BHPC 1998a). In the summer, the river is at its lowest level and flows average 8,350 cfs in August. Winter discharge averages 73,200 cfs in December. Discharge measurements were collected at a USGS gauging station downstream of the Project on the Willamette River (Station 14211720 – Willamette River at Portland, table 1) that included flow from the Clackamas River. In general, the highest flows in the Willamette River occur between November and February and can exceed 150,000 cfs. Nearly 70 percent of the annual discharge occurs from November to April. The lowest flows in the river occur from July to October.

Storage and Water Release

Thirteen reservoirs impound waters along tributaries to the Willamette River in the basin, while others impound waters in the Middle and Coast forks (table 2). Two reservoirs are located on the McKenzie River, one on the Long Tom River, and four reservoirs on the Santiam River (table 2). The largest are Detroit, Lookout Point, and Green Peter lakes. Collectively, these 13 reservoirs have a total storage capacity of approximately 1.8 million ac-ft (Shearman 1976) that is managed for multiple uses, including flood protection, power generation, navigation, irrigation, recreation, and domestic water supply (Uhrich and Wentz 1999). These reservoirs affect the flows at the Project, especially during summer when base flows are greater than those under an unregulated flow regime. The Project is operated as a run-of-river facility with no usable storage capability. Inflow through the two powerhouses returns to the river immediately downstream of the Falls. Figure 2 shows the monthly flow exceedances for the Willamette River at the USGS station below the Falls in Portland.

Figure 2. Probability of monthly flow exceedances for the Willamette River at Portland (USGS station 1411720) shown for probabilities of 5, 50, and 95 percent.

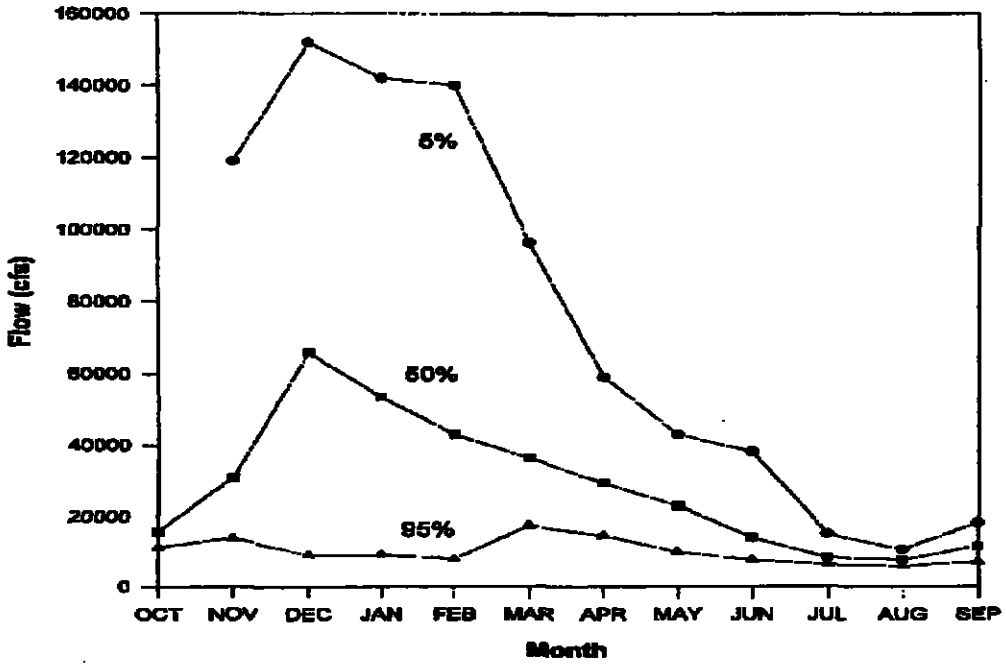

Table 2. U.S. Army Corps of Engineers reservoirs in the Willamette River Basin.

Name	Year Completed	Storage Capacity (ac-ft)	River	Subbasin
Fern Ridge Lake	1941	110,000	Long Tom River	Long Tom
Cottage Grove Lake	1942	30,060	Coast Fork Willamette River	Coast Fork
Dorena Lake	1949	70,500	Row River	Coast Fork
Dexter Reservoir	1954	4,800	Middle Fork Willamette River	Middle Fork
Lookout Point Lake	1953	349,400	Middle Fork Willamette River	Middle Fork
Fall Creek Lake	1962	115,000	Fall Creek	Middle Fork
Hills Creek Lake	1962	249,000	Middle Fork Willamette River	Middle Fork

Name	Year Completed	Storage Capacity (ac-ft)	River	Subbasin
Cougar Lake	1964	165,100	South Fork McKenzie River	McKenzie
Blue River Lake	1968	85,000	Blue River	McKenzie
Foster Lake	1966	33,600	Middle Santiam River	Santiam
Green Peter Lake	1966	333,000	South Santiam River	Santiam
Detroit Lake	1953	340,000	North Santiam River	Santiam
Big Cliff Reservoir	1953	2,430	North Santiam River	Santiam

Effects of Flow Releases

The Willamette Falls Project affects water levels in the pool upstream of the dam but does not affect the free flowing reach downstream of the Project. Upstream pool levels are dependent on river discharge, and whether or not the seasonal flashboards are installed on the dam. Maintaining a minimum upstream water level is important for fish passage, navigational purposes, and power generation. During the summer when flashboards are installed, the pool level is maintained at an elevation of approximately 54 ft MSL providing approximately 45 ft of head at the Project. Hydraulic head is reduced to as little as 28 ft during periods of high flow when downstream water levels increase. The proportion of river flow that passes through Project facilities varies seasonally. In the summer, when flows may be less than 10,000 cfs, two-thirds or more of river flow passes through the powerhouses. In winter months, when river flows are greater than 60,000 cfs, 11 percent or less of the flow is diverted to the powerhouses.

Flows Released for Specific Purposes

With the exception of water released for the locks and canal operated by the Corps and the ODFW fishway (described below), flows are not released for specific purposes in the vicinity of Willamette Falls.

Flows Released at Special Times

At the T.W. Sullivan development, Units 1 and 13 are run preferentially over other units. Unit 1 provides attraction flow for an ODFW fishway entrance and Unit 13 allows operation of the T.W. Sullivan downstream migrant bypass facility. At the Blue Heron Paper Company (BHPC) development, current operations include a period when the units are shut down for approximately 13 weeks, typically from mid-February to mid-June, and in some years, a period in the fall, to facilitate maintenance and provide safe downstream

fish passage for a portion of downstream migrants.[3] The actual schedule for unit shutdowns is coordinated with ODFW based on the timing and abundance of downstream fish migration in the Willamette River. In addition to flows at the BHPC and T.W. Sullivan developments, a set of locks is operated by the Corps to aid navigation.

Water Rights

Nine hydroelectric projects are operated in the Willamette River Basin upstream of the Project, eight by the Corps and one by the Eugene Water and Electric Board. Significant withdrawals of water for agriculture and public water supply also occur upstream. The City of Corvallis uses the Willamette River as its municipal water supply in the summer. Other upstream cities use tributaries of the Willamette River or wells to supply their water needs (PGE and BHPC 1998a).

Within the Project boundary, PGE claims pre-1909 use of Willamette River flow under a surface water registration claim (SWR-385) filed with the Oregon State Water Resources Department in December 1992. The T.W. Sullivan development has a claim to withdraw up to 6,850 cfs for power generation. The BHPC development has claim for withdrawal of 898 cfs for power generation. These claims are based on the water required to generate at authorized capacity based on turbine ratings during "yearly maximum river flows" producing about 35 ft of head, which occurs at several times during almost every year. When river flow is less than the "yearly maximum river flow", and the head available for turbine operation is subsequently greater, the full withdrawal of flows are not needed. Historical water use at each facility is provided in SWR-385. The ODFW uses up to 1,080 cfs for ladder operations, of which 650 cfs is part of SWR-385. Lastly, industrial processes at the two paper mills have claims to withdraw 110.2 cfs. Another claim at the time of filing SWR-385 was for the Simpson Paper Company development that no longer generates hydroelectric power at Willamette Falls, and is not part of this relicensing process.

PGE currently holds Power Claim PC-25 power production at Willamette Falls at both T.W. Sullivan and BHPC powerhouses in addition to flow needs for paper mill process water and ODFW fish ladder operations. PGE maintains PC-25 for 11,864.2 cfs of Willamette River flow through annual payments to OWRD as required by ORS 543.720.

Through agreement among the users, water use at Willamette Falls currently follow the following guidelines:

1. Flow is used at all times to supply and process water to the paper mills and to operate the ODFW fish ladder;

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[3] PGE and BHPC filed an application on October 7, 2003, to transfer of license of the BHPC Project. PGE proposes to decommission the BHPC Project.

2. Flow next is used at the BHPC powerhouse to operate on 0.75 MW and then at T.W. Sullivan to operate six units generating 9 MW;

3. Flow then is used at the BHPC powerhouse to operate two units at 1.5 MW, followed by operation of all 13 T.W. Sullivan units to generate 16 MW;

4. Remaining flow passes over the Willamette Falls.

Water Quality

The applicants conducted water quality monitoring studies from June 2000 to early November 2001, in consultation with the ODEQ, to assess the effects of the Project operations on water quality (2001b and 2002a). Particular emphasis was placed on temperature, dissolved oxygen (DO), and total dissolved gas (TDG), which have the greatest potential to be affected by the Project. Water quality related parameters not affected by the Project, and therefore not emphasized in the studies, included turbidity, pH, coliform bacteria, bacterial pollution, objectionable liberation of dissolved gases, creation of tastes and odors, aesthetic conditions, radioisotopes, total dissolved solids, development of fungi, and nuisance phytoplankton growth.

Water Quality in the Project Pool and Downstream

The Willamette River has experienced periods of poor water quality. Conditions have improved since the 1960s as a result of clean-up programs, primarily during the 1960s and 1970s, which reduced point and non-point sources of pollutants in the Willamette River Basin (PGE and BHPC 1998a). Data collected from the Willamette River indicate that the concentrations of most water quality constituents have declined since the 1960s (Mullane 1997). Concentrations of dissolved oxygen (DO), sodium, and levels of pH, however, have not followed this trend. Instead, these metrics have increased. Increases in sodium may be related to fertilizer use in the watershed, return flow from agricultural irrigation, or water disinfection processes in sewage discharge and drinking water supplies (PGE and BHPC 1998a). Increases in pH are possibly related to increases in primary productivity in the system and commensurate use of CO_2 during photosynthesis (PGE and BHPC 1998a). DO concentrations increased in the 1970s in response to secondary treatment of municipal sources (Tetra Tech, Inc. 1995).

The reach of the mainstem river from Willamette Falls upstream to the Yamhill River is 303 (d) listed (1998) for bacteria (fecal coliform), biological criteria (fish skeletal deformities), temperature, and toxics (mercury in fish) (PGE and BHPC 1998a). The lower Willamette River downstream of the Project also does not meet all water quality standards and is listed as water quality limited for the same criteria as the reach above the Project.

There are 320 National Pollutant Discharge Elimination System (NPDES) permitted discharges to the Willamette River. Most of these discharges (77.5 percent) are considered industrial discharges, 18 percent are domestic, and 4.5 percent are agricultural (PGE and BHPC 1998a). In the Willamette Basin, 33 discharges are classified as major by the Oregon Department of Environmental Quality (ODEQ). NPDES discharge information is summarized in Willamette River Basin Water Quality Study—Phase 1 (Tetra Tech 1992) (table 3). There are no sources of pollutants associated with the Project.

Table 3. Effluent discharge locations for major NPDES permittees in the Willamette River Basin. (Source: Tetra Tech 1992a).

Permittee	Discharge Type	SIC Code	Receiving Water	River Mile
Metropolitan Wastewater Management Commission	Municipal	Publicly Owned Treatment Works (POTW)	Willamette River	178.0
James River Paper Company, Inc.	Industrial	Pulp and/or Paper Mills	Willamette River	147.4
Pope & Talbot, Inc.	Industrial	Pulp and/or Paper Mills	Willamette River	147.4
Evanite Fiber Corp.	Industrial	Wood Products	Willamette River	132.2
Cottage Grove, City of	Municipal	POTW	Coast Fork of Willamette River	21.5
Weyerhaeuser Company	Industrial	Pulp and/or Paper Mills	McKenzie River	14.7
Corvallis, City of	Municipal	POTW	Willamette River	131.0
Albany, City of	Municipal	POTW	Willamette River	119.0
Willamette Industries, Inc.	Industrial	Pulp and/or Paper Mills	Willamette River	116.5
Salem, City of	Municipal	POTW	Willamette River	78.2
Oregon Metallurgical Corp.	Industrial	Smelting and Refining Facilities	Oak Creek	2.0
Teledyne Industries, Inc.	Industrial	Smelting and Refining Facilities	Truax Creek	0.4
Sweet Home, City of	Municipal	POTW	South Fork of Santiam River	33.6
Lebanon, City of	Municipal	POTW	South Fork of Santiam River	17.4
Dallas, City of	Municipal	POTW	Rickreall Creek	8.5
Newberg, City of	Municipal	POTW	Willamette River	50.3
BHPC Newsprint Corp. - Newberg	Industrial	Pulp and/or Paper Mills	Willamette River	50.0

Permittee	Discharge Type	SIC Code	Receiving Water	River Mile
Wilson, City of	Municipal	POTW	Willamette River	39.0
Canby, City of	Municipal	POTW	Willamette River	33.0
BHPC Newsprint Corp. - Oregon City	Industrial	Pulp and/or Paper Mills	Willamette River	27.5
McMinnville, City of	Municipal	POTW	Yamhill River	4.0
Woodburn, City of	Municipal	POTW	Pudding River	21.5
Unified Sewerage Agency[1] of Washington County (Forest Grove)	Municipal	POTW	Tualatin River	56.7
Unified Sewerage Agency[1] of Washington County (Hillsboro)	Municipal	POTW	Tualatin River	44.0
Unified Sewerage Agency[a] of Washington County (Rock Creek)	Municipal	POTW	Tualatin River	38.0
Unified Sewerage Agency[1] of Washington County (Durham)	Municipal	POTW	Tualatin River	9.6
Portland, City of	Municipal	POTW	Willamette River	20.3
Oak Lodge Sanitary District	Municipal	POTW	Willamette River	20.1
Clackamas County Service District #1	Municipal	POTW	Willamette River	18.5
Elf Atochem North America, Inc.	Industrial	Alkali and Chlorine Chemicals	Willamette River	7.4

[a] United Sewerage Agency changed its name to Clean Water Services in 2001

In 2002, a CE-QUAL-W2 computer model was developed for the Willamette River from the Falls at river mile (RM) 26.5 upstream to Salem, Oregon (RM 85). The model, developed and run by Portland State University (PSU) Civil Engineering Department, was used to interpret the field data that had been collected and analyzed as well as determine Project influence on water quality parameters through simulated model runs with project structures present and removed.

Dissolved Oxygen

Applicable Water Quality Standard:

For waterbodies identified by the Department as providing cold-water aquatic life, the DO shall not be < 8.0 mg/l as an absolute minimum. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/l, DO shall not be less than 90% of saturation. At the discretion of the Department, when the Department determines that adequate information exists, the DO shall not fall below 8.0 mg/l as a 30-day mean minimum, 6.5 mg/l as a 7-day minimum mean, and shall not fall below 6.0 mg/l as an absolute minimum.

"Cold-water aquatic life" is a beneficial use in all waters potentially affected by the Project. Therefore, the cold-water aquatic life criteria set forth in OAR 340-041-0445(2)(a)(D) apply to these waters. The OARs have more stringent criteria for protecting spawning, incubating, and emerging salmonids. However, these rules do not apply to reaches affected by the Project, since these species do not spawn in Project affected reaches. Therefore, the cold-water aquatic life criteria apply year-round to all Project affected reaches, except from July 1 to September 15.

ODEQ applies the cool water criterions (6.5 mg/L) from July 1 to September 15 from the mouth of the Willamette River to River Mile 107, which is well above the locations sampled for this application. "Cool-water aquatic life" is a sub-category of cold-water aquatic life and is defined under OAR 340-41-006 (52) as "the aquatic communities that are physiologically restricted to cool waters, composed of one or more species having dissolved oxygen requirements believed similar to the cold-water communities."

DO measurements were made by the applicants during the 2000 and 2001 monitoring program, which monitored DO conditions at six locations along the Willamette River between RM 63.5 and RM 25.5 (Normandeau Associates, Inc. 2001b, 2002c). At each location, DO levels were measured from the surface to the bottom at three sites across the river. DO concentrations ranged from 1.8 milligrams per liter (mg/L) to 12.4 mg/L. Lateral differences in DO levels appear to be small based on the mean and maximum DO concentrations. However, minimum DO concentrations differed substantially across the channel at some of the locations. The largest difference occurred at the powerline monitoring site, which is at RM 29.0. At this location, the minimum DO

concentration for the east, middle, and west of the channel was 1.8, 4.2, and 6.2 mg/L, respectively. Canby Ferry was the only other location that had differences of more than 2.0 mg/L in minimum DO levels.

Table 4. Seasonal water quality in the Willamette River collected above Willamette Falls at Canby Ferry (RM 35.0) and below Willamette Falls at Hawthorne Bridge (RM 13.1)[b].

	Above Project		Below Project		Above Project		Below Project	
	Fall				Spring			
Parameter	mean	Std dev	mean	Std dev	mean	Std dev	mean	Std dev
Total Alkalinity (ppm)	20.03	4.45	23.36	4.34	20.24	3.48	24.75	3.47
Temperature (°C)	**15.64**	5.19	**15.06**	5.44	**15.90**	5.52	**16.61**	6.37
Turbidity (NTU)	8.23	9.94	8.33	6.84	6.64	8.62	6.53	4.70
Color	11.74	9.97	18.63	14.80	14.06	14.81	22.28	17.40
Specific Conductance (μ S/cm)	62.19	11.63	69.88	12.82	64.18	10.67	76.82	12.29
Dissolved Oxygen (ppm)	**8.32**	1.71	**10.16**	2.04	**8.22**	1.72	**9.63**	2.32
pH	7.21	0.36	7.31	0.08	7.34	0.19	.40	0.12
NH_4 (ppm)	0.16	0.20	0.07	0.03	0.20	0.25	0.07	0.02
NO_3 (ppm)	0.41	0.26	0.46	0.23	0.42	0.27	0.40	0.20
TP (ppm)	0.12	0.12	0.11	0.05	0.09	0.03	0.10	0.03
Ca (μeq/L)	300.31	47.43	313.43	43.55	316.12	40.22	325.00	39.70
Mg (μeq/L)	161.53	30.52	165.03	25.41	168.63	25.94	175.00	25.44
Na (μ eq/L)	194.95	64.42	231.08	75.96	199.76	51.13	244.00	68.55
K (μ eq/L)	18.29	4.79	19.74	5.97	19.76	5.10	23.00	11.87
SO_4 (μ eq/L)	81.85	51.83	70.82	11.41	94.35	65.28	73.00	27.27
Cl (μ eq/L)	118.95	50.91	112.84	23.03	123.69	51.51	103.00	34.16

	Above Project		Below Project		Above Project		Below Project	
	Summer				Winter			
	mean	Std dev	mean	Std dev	mean	Std dev	mean	Std dev
Total Alkalinity (ppm)	21.02	4.28	22.25	3.86	20.32	4.80	24.00	3.42
Temperature (°C)	**15.95**	5.56	**15.56**	6.20	**15.65**	5.16	**14.23**	5.35
Turbidity (NTU)	9.19	13.32	7.89	5.87	7.04	8.94	9.12	8.76
Color	15.91	17.03	19.41	17.58	11.11	9.81	22.59	16.33
Specific Conductance (μ S/cm)	64.35	11.61	70.50	11.60	62.62	10.41	71.62	14.32
Dissolved Oxygen (ppm)	**8.23**	1.72	**10.06**	2.10	**8.32**	1.65	**10.52**	2.02
pH	7.23	0.25	7.28	0.13	7.25	0.23	7.36	0.22
NH_4 (ppm)	0.17	0.19	0.07	0.02	0.16	0.19	0.08	0.06
NO_3 (ppm)	0.46	0.30	0.46	0.28	0.43	0.26	0.50	0.29
TP (ppm)	0.09	0.02	0.11	0.04	0.10	0.03	0.11	0.05
Ca (μeq/L)	316.11	38.17	315.04	35.11	313.18	32.45	319.36	41.48
Mg (μeq/L)	166.31	27.16	167.81	22.82	170.79	21.75	170.00	27.27
Na (μeq/L)	199.53	62.70	229.51	71.68	218.00	60.79	228.51	69.83
K (μ eq/L)	20.28	7.44	21.56	4.70	18.81	5.30	20.39	6.59
SO_4 (μ eq/L)	90.10	62.80	72.90	25.51	89.53	60.74	74.99	27.95
Cl (μ eq/L)	126.49	57.05	135.41	30.90	135.16	102.26	112.84	28.21

[a] Data presented in this table are expected to be influenced by discharge from the Clackamas and Tualatin Rivers and several identified point and non-point discharge locations into the Willamette River between these two study sites.

[b] The data are from the ODEQ ambient monitoring program and were obtained from EPA's storage and retrieval (STORET) database.

Some of the sites monitored experienced apparent stratification in DO between the surface and streambed. Review of the largest within vertical profile differences shows that four of the 21 monitored sites had DO concentrations that varied by more than 3.0 mg/L within at least one vertical profile. Differences of more than 3.0 mg/L were rare during the 2000/2001 monitoring period. The largest within-profile differences occurred at the mid-channel Canby Ferry site, and the east powerline site. Within-profile differences of DO was largest during late June and early July 2000. All of the monitoring events that occurred during other periods had differences of <2.0 mg/L between the surface and streambed.

During June 22, 2000, DO concentrations steadily decreased from 8.4 mg/L at the surface to 3.0 mg/L at the streambed (depth of 15 meters) at the Canby Ferry mid-channel site. Although DO concentrations varied more throughout the water column on July 6, 2000, a much larger portion of the water column experienced DO concentrations of more than 6.0 mg/L. In contrast, DO levels were < 6.0 mg/L throughout a much larger portion of the water column at the east of the powerline site on July 6, 2000 than June 22, 2000. There was no sign of similar low DO levels during 2001.

To further evaluate the potential impact of the Project on DO levels, the applicants used computer modeling of DO levels upstream of the Project (Berger 2002). This modeling indicated no stratification and that DO levels were affected to a small degree by the increased residence times resulting from the presence of the dam and flashboards. In general, DO concentrations were slightly higher for the no-flashboards and no-dam scenarios in all flow conditions, because lower residence times reduced the impact of sediment oxygen demand (SOD). This reflects the fact that there is very little algal photosynthesis in the Project reach; but there is SOD. In 2001 the modeled maximum difference observed in the no-dam scenario was an increase of DO concentrations of 0.18 mg/L (Berger 2002). This difference between the scenarios do not account for the localized low DO concentrations that are observed. Rather, those are the result of specific sediment conditions that exist in particular locations.

Biochemical oxygen demand (BOD) concentrations collected from the 1950s through 1999 indicate a relatively low biochemical demand for oxygen in the river at Canby Ferry and at Portland, with most values falling between 0.5 and 2.5 parts per million (ppm) (EPA STORET data presented in PGE and BHPC 1998a).

Oxygen depletion by bottom sediments can be an important component in oxygen budgets (USGS 1994). Decomposition of organic matter within bottom sediments is the primary cause of oxygen depletion in the Willamette River in areas where there are mud and silt sediments. SOD rates measured in the Willamette River in 1994 were relatively constant upstream and downstream of the Project (USGS 1994). SOD rates ranged from 0.008 lb/ft^2/day at RM 6.3 to 0.0026 lb/ft^2/day at RM 31.5 and 19.4, and averaged 0.00042 lb/ft^2/day (USGS 1994). SOD rates measured in 1994 are similar to rates in the

Tualatin River (USGS 1994) and in previous SOD surveys in the Willamette River (Thomas 1970). Natural conditions in the Willamette River since 1969 have remained relatively constant, with minimal impacts from industrial or municipal sources of organic matter (USGS 1994).

Temperature

Applicable Water Quality Standard (fundamental):

To accomplish the goals identified in OAR 340-041-0120(11), unless specifically allowed under a Department-approved surface water temperature management plan as required under OAR 340-041-0026(3)(a)(D), no measurable surface water temperature increase (defined as greater than 0.25°F [0.14°C]) resulting from anthropogenic activities is allowed . . . [specifying criteria under which no measurable surface water temperature increase is allowed].

Applicable Water Quality Standard (numeric and narrative criteria):

The following additional criteria apply to waters affected by the Project:

- In the Willamette River or its associated sloughs and channels from the mouth to RM 50 when surface water temperatures exceed 68.0°F (20.0°C);
- In stream segments containing federally listed Threatened and Endangered species if the increase would impair the biological integrity of the Threatened and Endangered population; and
- In Oregon waters when the DO levels are within 0.5 mg/l or 10% saturation of the water column or intergravel DO criterion for a given stream reach or subbasin.

During most years, the 7-day running average of the daily maximum temperature exceeds the 68°F criterion during July 1 to September 15. Thus, the "no additional heating" clauses of the water quality standard are invoked over the whole year in this reach of the Willamette River.

Exceptions:

There are two general exceptions to the temperature criteria. They do not apply "when the air temperature during the warmest seven-day period of the year exceeds the 90th percentile of the seven-day average daily maximum air temperature calculated in a yearly series over the historic record." OAR 340-041-0445(2)(b)(B). They also do not apply if a temperature in excess of the criterion is "naturally occurring." OAR 340-041-0445(3). See also OAR 340-041-0120(11)(c).

Studies in the Willamette River were conducted to better understand temperature fluctuations. In 2000 and 2001, water temperatures in the Willamette River were monitored by the applicants to determine the influence of flashboard installation, potential diel changes, potential thermal stratification, and to document the natural variability of water temperatures during the year. Flashboard installation did not appear to significantly influence water temperatures in the region sampled. The observed variability in water temperatures upstream and downstream of the dam was similar during the periods prior to and after the installation of the flashboards.

CE-QUAL-W2 modeling and water quality data collected during 2000 and 2001 indicated that the seven-day running average temperature (7DMXs) of the Willamette River exceeded 20 degrees Celsius (°C) throughout most of the reach evaluated (RM 85 to RM 26) during nearly all of July and August, and about 10 percent of June 2001. These included sampling sites above the Project influence at RM 63.5 as well as within and below the Project pool. Lateral differences in water temperatures was less than 2.0°C based on the minimum, maximum, and mean temperatures recorded for each of the sites. Vertical stratification was not observed, although within water column differences of more than 4.9°C occurred near RM 26.8 during mid-June 2001, late July 2000, and mid-August 2001. Evaluating the levels of longitudinal rates of change in 7DMXs does not reveal consistent trends. CE-QUAL-W2 modeling did not show an increase in 7DMXs due to Project presence during periods of high temperature. The model did show some shifting in longitudinal location of maximum temperatures upstream, beginning at approximately RM 54, with Project structures present due to the increased travel time associated with the Project pool (Berger 2002).

Total Dissolved Gas (TDG)

Applicable Water Quality Standard:

The concentration of TDG relative to atmospheric pressure at the point of sample collection shall not exceed 110% of saturation, except when stream flow exceeds the ten-year, seven-day average flood. However, for Hatchery receiving waters and waters of less than two ft in depth, the concentration of TDG relative to atmospheric pressure at the point of sample collection shall not exceed 105% of saturation.

The TDG values recorded during the 2000/2001 monitoring period (late June - early November of 2000 and May – August of 2001) remained below 110 percent at all of the monitored sites with the exception of sites immediately below the Willamette Falls (within the horseshoe of the Falls) where nine (22 percent) of the 41 measurements exceeded 110 percent. Measured values ranged from 111 to 115 percent and usually occurred when river flows exceeded 7,000 cfs and flows over the Falls exceeded 500 cfs. TDG levels were less than 110 percent at the monitored sites downstream just below where the T.W. Sullivan tailrace and BHPC powerhouse discharges enter the main river

channel. TDG levels recorded for the T.W. Sullivan forebay, T.W. Sullivan tailrace, and BHPC tailrace indicate that TDG levels are generally reduced as water passes through the Project's generators. The lower TDG of water discharged from the powerhouses tended to reduce TDG levels in the main river channel below the Project by dilution in the range of flows measured (approx. 6,000 to 15,000 cfs).

Additional TDG measurements were obtained at several sites below the Falls at much higher flows during the winter of 2001/2002. As flows increase at the Falls, water surface elevation at the base of the Falls increases proportionately more than above the Falls, thereby increasing the depth of water available for flow over the Falls to plunge. TDG measurements were obtained at estimated flow at the Falls of 65,250 cfs, 61,800 cfs, 39,000 cfs, and 24,500 cfs. TDG levels were higher (120, 116, 110, and 108 percent respectively) and persisted at all the sampling sites for several miles downstream.

At the lower river flows that existed during the sampling in June to October 2000 and May to October 2001, the plunging mechanism that creates supersaturation exists at several locations around the Falls where deep pools have been scoured at the base of the Falls. Once this higher TDG water mixes with the discharges from the powerhouses, however, TDG is diluted to less than 110 percent. At higher river flows during the December 2001 to March 2002 period, when TDG values as high as 120 percent were detected and persisted for several miles downstream, the plunging mechanism may exist within the entire horseshoe area of the Falls as the plunge depth within the Falls increases due to the geologic structure of the Falls, not the Project structures. In either instance, the Project is not contributing to the conditions that create the high TDG levels.

Use Classifications Of Water Bodies

Water bodies upstream of the Project to Newberg and downstream to the mouth of the Columbia River are used for municipal water supply, irrigation and agriculture, aquatic and terrestrial habitat enhancement, and recreation (table 5).

Table 5. Designated beneficial uses for the Willamette River and its major tributaries.

Beneficial Uses	Clackamas River	Molalla River	Tualatin River	All Other Streams and Tributaries	Mouth to Willamette Falls, including Multnomah Channel	Willamette Falls to Newberg
Public Domestic Water Supply[a]	X	X	X	X	X	X
Private Domestic Water Supply[a]	X	X	X	X	X	X
Industrial Water Supply	X	X	X	X	X	X
Irrigation	X	X	X	X	X	X
Livestock Watering	X	X	X	X	X	X
Anadromous Fish Passage	X	X	X	X	X	X
Salmonid Fish Passage	X	X	X	X	X	X
Salmonid Fish Spawning	X	X	X	X		
Resident Fish and Aquatic Life	X	X	X	X	X	X
Wildlife and Hunting	X	X	X	X	X	X
Fishing	X	X	X	X	X	X
Boating	X	X	X	X	X	X
Water Contact Recreation	X	X	X	X	X	X
Aesthetic Quality	X	X	X	X	X	X
Hydro Power	X	X	X	X	X	X
Commercial Navigation and Transportation				X	X	X

- a. With adequate pretreatment, water quality meets drinking water standards.

b. Environmental Impacts and Recommendations:

The ODEQ is the lead agency regarding meeting the water quality standards through its 401 Water Quality Certification process. The applicants filed a revised 401 water quality certification application on November 21, 2003. ODEQ has not yet issued the final certification for the Project. In a letter filed by the Oregon Water Resources Department on March 1, 2004, the Oregon state agencies believe the Settlement Agreement filed on February 2, 2004, is in the public interest, and upon Section 401 certification by ODEQ, support issuance of a new license for the Project incorporating the Settlement Agreement and its Proposed License Articles without material modification.

The following sections describe the applicants' plans for improving water quality at the Project. Additional measures may be required by ODEQ following its review of the applicants' 401 water quality certification application.

Water Quantity

Stream Flow

No specific stream flow issues were identified during the NEPA scoping process. The Project is operated as run-of-river, and Project structures do affect river elevation to varying degrees 25 to 30 miles upstream. The pool elevation upstream of the Project does vary with river flow, but at lower summer/early fall flows, it is maintained near or above 54 ft MSL. This elevation is maintained , in part, to accommodate multiple water users, including Project powerhouses, the ODFW fish ladder, the Canby Ferry, and the Corps' locks. The T.W. Sullivan and BHPC Developments use up to 6,850 and 898 cfs, respectively, at high river flow conditions. However, during most river flow conditions, typical use is 5,850 and 800 cfs, respectively. The ODFW fish ladder uses up to 1,080 cfs. Any Willamette River discharges greater than the combination of flow through the powerhouses and fish ladder (approximately 7,800 cfs) pass over the Falls. During the summer, river discharges may fall below 7,800 cfs, with little or no water flowing over the Falls other than through locations where flashboard sections are left out to minimize stranding of upstream migrating fish. The seasonal installation of 2-foot flashboards on top of the dam helps to maintain river levels upstream of Willamette Falls.

The CE-QUAL-W2 model showed that the river elevation upstream of Willamette Falls is affected up to approximately RM 56 (Willamette Falls is at RM 26.5). Modeled travel time, based on 2001 flows, between these two river miles without Project structures (i.e., without the dam and flashboards) is 2.8 days, increasing to 3.8 days with just the dam modeled and 4.1 days with the flashboards installed (Berger 2002).

Effects of T.W. Sullivan Forebay, Powerhouse, and Tailrace Modifications—At very low river flows, the routing of approximately 500 cfs through the proposed siphon

spillway would visibly reduce flow over the Falls (MWH 2001), but would not have an effect on upstream river conditions.

Effects of Modifications to Dam—The controlled-flow structure at the apex of the dam would be designed to maintain upstream water surface level at its present level. Flow over the Falls would be focused at the apex of the Falls instead of around the perimeter of the Falls, but overall river flow would not be affected.

Effects of BHPC Shutdown Program—With the shutdown of the BHPC powerhouse, flow over the Falls would increase, but overall river flow would not be affected.

Staff Analysis

The Project operates in a run-of-river mode, and no change in the Project's current storage capacity is proposed. Flows over the Falls and through the project can affect water quality downstream of the Project. The shutdown of the BHPC would increase the flows over the Falls, which may affect water quality downstream. These impacts are discussed in the following Water Quality section. Final 401 certificate conditions have not yet been filed by ODEQ.

Water Quality

Dissolved Oxygen (DO)

Numerous DO samples collected by the applicants above and below the Falls did not meet the state water quality standards during the water quality studies. To further evaluate the potential impact of the Project on DO levels, the applicant used a water quality computer model for the area upstream from the Project. Modeling of DO from RM 56 to the Falls (at RM 26.5) was done to better understand field measurements and to predict how DO concentrations varied with location and depth as the water traveled downstream in each of the three modeled scenarios: a base case (existing) scenario of the dam with flashboards, a scenario of a dam with no flashboards, and a scenario with no dam. This modeling indicated that DO levels were affected to a small degree by the increased residence times resulting from the presence of the dam and flashboards. The modeling also showed that low DO levels are similar to what exists naturally upstream of the Falls. The following discussion covers three distinct time periods in June through September.

The model results described below are based on 2001 flow conditions of between 5,000 to 7,000 cfs at Salem during the modeled period. DO levels would be expected to improve with higher flows during this period (PGE 2003).

- <u>During the month of June, when the DO standard is 8.0 mg/L</u> – Only two modeled scenarios, the no dam and the dam with no flashboards, are relevant, because

flashboards are not installed until July. DO levels that do not meet the standard are present in both scenarios. Levels less than 8.0 mg/L first appear in the deeper holes just upstream of the Project in the no dam scenario on June 19. The dam with no flashboard scenario shifted the onset of non-compliant water earlier by approximately 1.5 days. As the areas of water with DO less than 8.0 mg/L increase in volume and extend further upstream of the Falls for both the no dam and dam with no flashboards scenarios, the dam with no flashboards scenario tended to shift the onset further upstream by approximately 3.5 miles (from RM 39.5 up to RM 43). During the period of time with DO less than 8.0mg/L, DO concentrations remained above 7.5 mg/L with only a relatively small section, just upstream of the Falls, between 7.5 mg/L and 7.0 mg/L for several days.

- During the period from July 1 through September 15 when the DO standard is 6.5mg/L - The modeled contour plots for all three scenarios show no areas of non-compliant water upstream of the Falls. Modeled DO was greater than 6.5 mg/L throughout the reach during the entire period.

- On September 16, the DO standard returns to 8.0 mg/L. Again, low DO occurs in all three scenarios modeled. The dam, and dam with flashboards, increase the duration, by approximately 2-3 days, it takes for compliant water to travel downstream to the Falls. Modeling results show that on September 16, when the DO standard changes from 6.5 mg/L to 8.0 mg/L, the most upstream point with DO less than 8.0 mg/L is approximately 10.5 miles upstream of the Falls (RM 37) in the no dam scenario and approximately 15 miles upstream (RM 41.5) for the dam and the dam with flashboards scenarios. All waters upstream of the Falls in all three scenarios are in compliance with the DO standard after about September 22.

Water Temperature

Willamette River 7DMX exceeded the applicable numeric criterion of 20°C throughout most of the reach evaluated (RM 63.5 to RM 25.9; Note: Willamette Falls is at RM 26.5) during nearly all of July and August in 2000 and 2001, and about 10% of June 2001. Summer temperatures generally increase between RM 63.5 and 61.5, remain stable between RM 61.5 and RM 26.8, exhibit marked cooling between RM 26.8 and 26.5, and warm somewhat between RM 26.5 and RM 25.9. These results indicate that the Project does not elevate summer 7DMX in the Willamette River.

To further evaluate the potential impact of the Project on temperature, the Applicant used a water quality computer model for the area upstream from the Project (Berger 2003). Temperatures were modeled between approximately RM 27 to 56 for three scenarios 1) base case with the dam and flashboards, 2) dam without flashboards, and 3) no dam. Special attention was given to the temperature differences between scenarios with project structures in place and the no dam scenario. Daily maximums and flow-and volume-weighted 7DMX values were modeled.

In general, the increased volume of water upstream of the Falls, and associated thermal mass, tended to slow the increase in 7DMX temperatures, and yield lower 7DMX temperatures, with Project structures in place compared to the no dam scenario.

The average temperatures from Salem to Willamette Falls were modeled for the three scenarios described above. Because of the faster travel time of the no dam scenario, its temperature peak was gradually displaced further downstream than those of the base or no flashboard scenarios. Additionally, the lower water level associated with the no dam scenario allows the water to respond more to diurnal heating and cooling; hence, slightly higher temperatures may be found during the day.

The seven day average of daily maximum temperatures for the modeled scenarios were graphed at 19 river locations. Results indicate that the Project does not increase temperatures in the Project reach. In fact, for the no dam scenario, the model predicts a maximum temperature difference above the base case scenario of approximately 0.35°C. Modeling results showed that the increased volume of water upstream of the Falls with the dam and the flashboards in place tended to provide an overall temperature reduction in the entire water body despite slightly increased surface temperatures.

Vertical temperature gradients were modeled at various flows to determine the contribution, if any, of the Project's presence. In general, results showed that gradients that were predicted to occur were reduced as flows increased. At 5,000 cfs, which is the minimum target flow for the river at Salem in dry years, the predicted gradient was less than 1.5°C for all three scenarios. Moreover, a comparison of the gradient at 6 a.m. and 4 p.m., the times of minimum and maximum diurnal heating, respectively, indicated that the gradients which were observed, and which disappeared at 6 a.m., were the result of diurnal heating, not a long-term stratification caused by the Project.

While temperatures in the affected reach above the Project exceed the temperature standard, the presence of the Project does not appear to result in a measurable temperature increase (i.e., in excess of 0.25F). Modeling results indicated that the proposed Project operations would meet the applicable standard.

Total Dissolved Gas (TDG)

The supersaturation of atmospheric gases in water may cause either crippling or lethal gas bubbles to form in the tissues of fish. The standard, based on scientifically derived evidence, is designed to prohibit discharges or activities that will result in atmospheric gases reaching known harmful concentrations.

Monitoring results showed that TDG levels sometimes exceed 110% of saturation either just within the horseshoe area of Willamette Falls or for several miles downstream. These high TDG levels coincide with water spilling over the Falls, which is a natural source of high TDG. At the lower river flows that existed during the sampling in June to

October 2000 and May to October 2001, the plunging mechanism that creates supersaturation exists at several locations around the Falls where deep pools have been scoured at the base of the Falls. Once this higher TDG water mixes with the discharges from the powerhouses, however, TDG is diluted to less than 110%. At higher river flows during the December 2001 to March 2002 period, when TDG values as high as 120% were detected and persisted for several miles downstream, the plunging mechanism may exist within the entire horseshoe area of the Falls as the plunge depth within the Falls increases due to the geologic structure of the Falls, not the Project structures.

Studies and relevant literature (Harvey and Cooper 1962, Lindroth 1957, and Marking 1987) indicate that TDG levels below the Falls are not elevated by water flowing over the dam and flashboards prior to flowing over the crest of the Falls. The dam and flashboards are set back from the edge of the Falls and the Falls, themselves, have a cascading nature. Water flows over the dam and flashboards and lands on the bedrock shelf that forms the Falls. The water then flows over the upper portion of the shelf before flowing over the ledge and plunging into pools at the base of the Falls. As river flow increases, the depth of the pools at the base of the Falls increases also. At very high flows, the entire horseshoe area of the Falls becomes a relatively deep pool. Therefore, the typical conditions that produce excessive concentrations of total dissolved gas are not present at the dam and flashboards at the Project. When spill occurs, the conditions are not amenable to producing gas supersaturation, because discharges over the Project dam enter shallow water at the top of the Falls and do not plunge to great depth. The plunging to depth is the cause of the elevated TDGs, which takes place as the water then flows over the Falls and into pools at the base of the Falls. This situation would exist whether the dam and flashboards were in place or not. The pattern of increasing TDG concentrations with increasing flow confirms that as water levels below the Falls increase (as occurs at increasing flows), TDG levels increase as well.

It appears that the Project is not contributing to the conditions that create high TDG conditions that occur solely within the horseshoe of the Falls at low flows or downstream of the Project at high flows. Nonetheless, the Applicant proposes to consult with ODEQ regarding the final design, construction, and operation of the controlled flow structure proposed at the apex of the Falls to ensure there are no adverse water quality impacts, specifically on TDG. The Applicant also envisions using a small-scale physical model to aid in this effort to provide reasonable assurance that the design and operation of the controlled flow structure will comply with the TDG standard.

Staff Analysis

The design and operation of the controlled flow structure at the apex of the Falls would take into consideration the potential impacts to water quality criteria. Small scale modeling of the structure and consultation with ODEQ would help assure that the state water quality criteria are met.

Additional water quality measures may be required by ODEQ when they issue a 401 Water Quality Certificate for the Project.

c. Unavoidable Adverse Impacts:

Water quality concerns in the Willamette River, both upstream of the Project and downstream, will continue to exist with or without the continued operation of the Project. Analysis of data collected and modeling indicates that while the Project may influence some water quality parameters under some conditions, that influence isn't significant.

3. Fisheries Resources

a. Affected Environment:

A wide variety of fish species occur in the vicinity of the Project, including six threatened, endangered, or sensitive species. Migratory fishes, including anadromous and adfluvial species, have the greatest potential to be impacted by the Project. The Willamette River is host to nine anadromous species. These include spring run chinook salmon, winter steelhead, coastal cutthroat trout, coho salmon, white sturgeon, pacific lamprey, fall run chinook salmon, bull trout, and summer steelhead. Fall run chinook salmon and summer steelhead have been introduced into the Willamette River upstream of Willamette Falls (falls). In addition, adfluvial bull trout and cutthroat populations are present in the Willamette Basin upstream of the Falls and have varying degrees of potential to migrate past the Project. To date, no bull trout have been documented at the Project but cutthroat trout have been collected in the fish bypass collector.

Timing of the migration of anadromous fish past the Project is important to assessing impacts. In general, the majority of smolts pass the Project from February to June (table 6). Species that migrate downstream during this period include hatchery and wild spring chinook salmon, hatchery and wild steelhead, coho salmon, fall chinook salmon, and Pacific lamprey. A secondary peak of wild spring chinook salmon smolts occurs during October and November. Downstream passage is provided by a fish bypass system at the T.W. Sullivan development. The adjacent Blue Heron Paper Company (BHPC) historically provided some downstream migrant protection at its facility by shutting down its turbines for 16 weeks during peak spring outmigration periods and a fall shutdown in some years.[4] Willamette Falls historically provided a natural barrier to upstream migration for anadromous fishes during lower flows in summer and fall. Under historical conditions, higher river flows in the winter and spring decreased the height of the Falls and allowed some anadromous fish species to move upstream. Upstream fish passage at the Project is possible because a fish ladder is operated and maintained by the ODFW. Mortality, injury, or delay has the potential to occur during upstream passage at

[4] PGE and BHPC filed an application on October 7, 2003, to transfer of license of the BHPC project. PGE proposes to decommission the BHPC project.

the Falls and may affect listed stocks of winter steelhead, spring chinook salmon, and other runs of anadromous salmonids.

When flashboards are installed on the dam, flows over the Falls cease for a limited period and can result in fish stranding in large scour pools at the base of the Falls. Observations made by the applicants and other resource manager personnel over the years indicate that anadromous species such as lamprey, spring chinook salmon, and summer steelhead have the greatest potential to be stranded below the Falls as they migrate past the Project because of the run timing of these fish and the timing of the flashboard installation. Adult spring chinook salmon are finishing their upstream migration over the Falls by July 31, summer steelhead migrate over the Falls all summer and into the fall, and Pacific lamprey are present and potentially migrating over the Falls during the early summer and into the fall. Flashboards are usually installed the first half of July. Similar to downstream migration, the timing of upstream migration past the Project is variable and species-specific.

The dam, and flashboards when installed, tend to redistribute flows around the crest of the Falls. This is more pronounced at low flows. This redistribution of flow can affect downstream migrants by altering flow patterns and velocity cues at the Falls for upstream guidance, or impeding their downstream passing over the dam due to shallow veil flows.

Table 6. Timing of anadromous species life history events in the Willamette River.

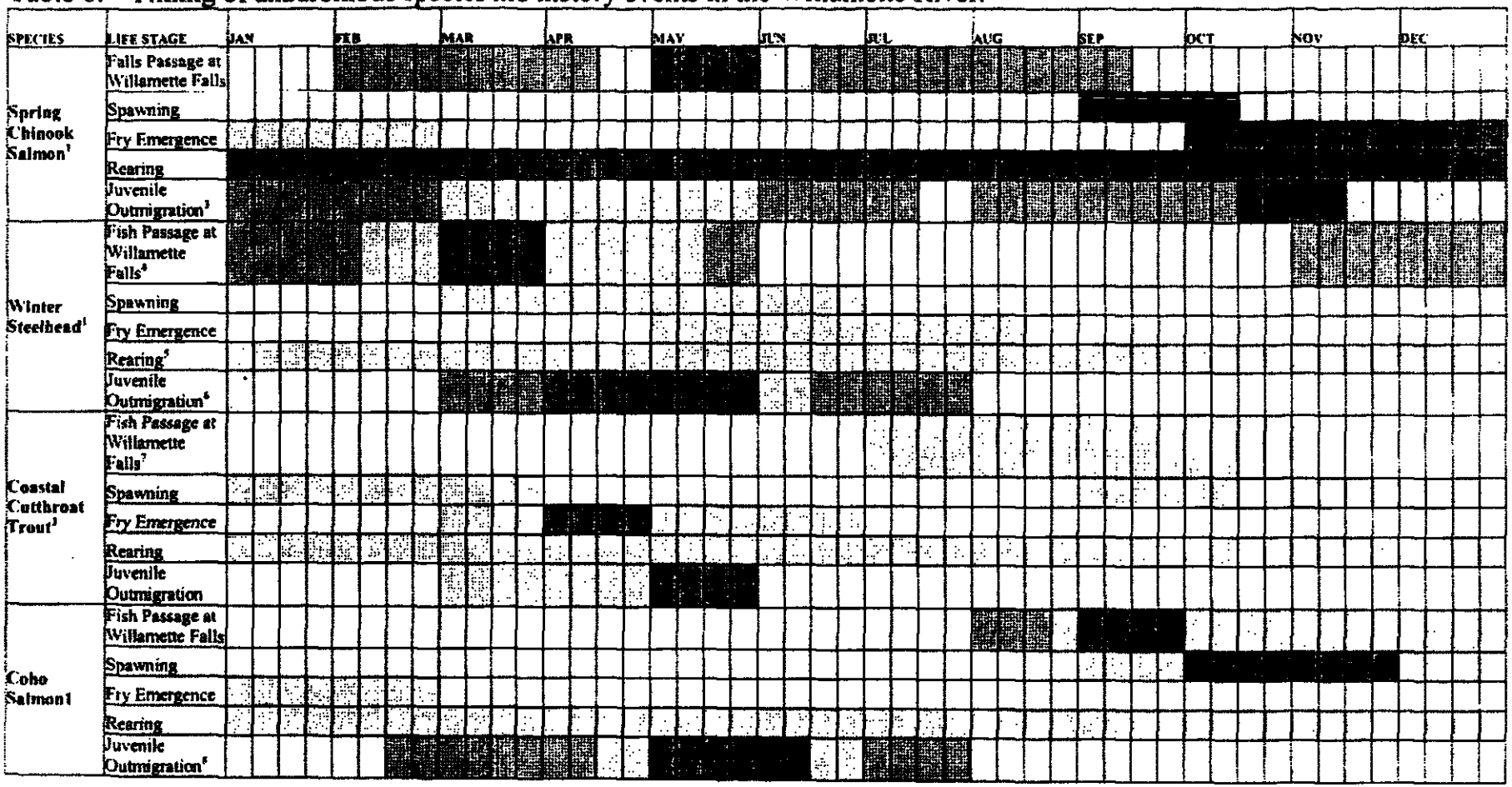
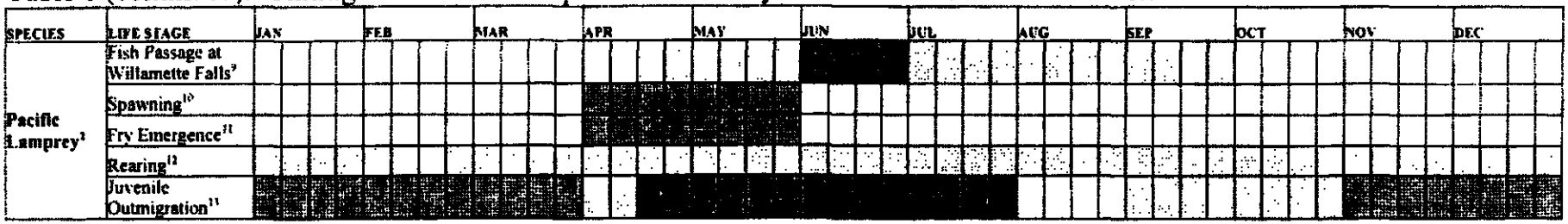


Table 6 (continued). Timing of anadromous species life history events in the Willamette River.



LEGEND

- Light Activity
- Moderate Activity
- Peak Activity
- Based on general life history references

1 Adapted from Stillwater Sciences 2001.
2 Normandeau Associates, Inc. 2001f: there is uncertainty on the life history of pacific lamprey in the Willamette River because little site-specific information is known.
3 In general, natural spring chinook outmigration peaks in late October. The least active period of outmigration for spring chinook salmon is June through mid-September. The peak downstream migration for hatchery spring chinook is in March. A spike of movement also occurs in November with fall-released fish (PGE and BHPC 1998a).
4 Winter steelhead passing Willamette Falls Project from November 1 to February 15 are mainly introduced Big Creek stock, and fish passing the Falls after February 15 are mainly the native Willamette stock (PGE and BHPC 1998a).
5 Naturally-spawned juveniles generally spend two years in freshwater before smolting and migrating downstream (PGE and BHPC 1998a).
6 Hatchery (Big Creek stock) introductions of winter steelhead into the Willamette River basin were discontinued in 1997.
7 No account of fish passage of cutthroat trout at Willamette Falls fish ladder in recent years (C. Foster, ODFW, personal communication).
8 All coho salmon hatchery releases upstream of Willamette Falls were discontinued in 1988 (except those in Tualatin River) (Foster 1994).
9 (D. Domina, PGE, personal communication).
10 Spawning takes place when temperatures are between 10-15 C (Beamish 1980, Beamish and Levings 1991, as cited in Stone et al. 2001).
11 Larvae hatch in about 19 days at 15 C (Pletcher 1963, as cited in Stone et al. 2001).

The redistributed flow over the Falls also has the potential to cause some downstream migrants to pass over the Falls at unsafe passage locations, due to rock outcroppings or rocky landing areas at the base of the Falls, instead of natural channels over the Falls.

In addition to the native migratory species, 23 introduced species are found within the lower Willamette River. Two runs of non-endemic salmonids, fall run chinook salmon and summer steelhead, have also been introduced into the upper Willamette River to enhance recreational angling. Other exotic species include, but are not limited to sockeye salmon (*O. nerka*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), American shad (*Alosa sapidissima*), and multiple warm water game fish such as bass (*Micropterus spp.*), crappie (*Pomoxis spp.*) and catfish (*Ictalurus and Ameirus spp*).

Threatened and Endangered Fish Species

Oregon Chub

Oregon chub (*Oregonichthys crameri*) was listed as endangered under the ESA.[5] This species is endemic to the Willamette River drainage. Historically, it was distributed throughout lower elevation backwater habitats; however, its range is currently restricted to a 30-km stretch of the middle fork of the Willamette River near Dexter, Oregon, well above the Project boundary. In addition, recent observations have documented small numbers of chub in the lower North Santiam River and in Gray and Lake Creeks. The current distribution of Oregon chub in the Willamette River represents about two percent of its historic range.

Populations of Oregon chub have decreased concurrent with changes and loss of backwater habitats, degradation of floodplain and riparian habitats, and introduction of exotic fish and amphibians. Oregon chub occupy habitats with low to zero velocity flow conditions, depositional substrates, and abundant aquatic and over-hanging riparian vegetation. The FWS did not designate critical habitat for this species. An interagency agreement between the ODFW, Oregon State Parks and Recreation, FWS, U.S. Army Corps of Engineers (Corps), United States Forest Service (FS), and United States Bureau of Reclamation (USBR) includes plans to protect habitat for conservation of this species and introduce new populations in available habitats (Kostow 1995).

Spring Chinook Salmon

Spring run chinook salmon (*Oncorhynchus tshawytsca*) is a native anadromous species of commercial, recreational, and Tribal importance. Consistent with regional trends for natural salmonid populations, Willamette River spring chinook have been

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[5] 58 FR 53800 (October 18, 1993).

declining. In 1999, spring chinook salmon populations upstream (upper Willamette Evolutionarily Significant Unit [ESU]) and downstream (lower Columbia ESU) of Willamette Falls were listed as threatened under the ESA.[6] Subsequent to the listing under the ESA, NOAA Fisheries withdrew its critical habitat designations for chinook salmon within the Project area (lower Columbia River and upper Willamette River ESUs).[7]

There are five large spring chinook salmon hatcheries in the Willamette River Basin upstream of the Project that operate consistent with ODFW hatchery management and basin plans. Four of the hatcheries, Marion Forks, South Santiam, McKenzie, and Willamette, are located more than 150 km upstream of Willamette Falls. The fifth hatchery, the Clackamas, is located downstream of the Project in the upper Clackamas River Basin. Together these hatcheries produce and release approximately 5 million spring chinook salmon smolts annually (ODFW 2001) into the Willamette River. In 2000, about 4.4 million spring chinook salmon smolts were stocked into the Willamette Basin.

Willamette River spring chinook salmon contribute to commercial, Tribal, and recreational fisheries. Between 1960 and 1999 spring chinook salmon adult and jack counts at Willamette Falls averaged 36,625 (range 14,400 in 1960 to 71,300 in 1990). Commercial harvest occurs in the Pacific Ocean and lower Columbia River before adults enter the Willamette River. In some years, depending on run size and river conditions, Willamette River spring chinook stocks are also used for Tribal subsistence and ceremonial fishing at Willamette Falls. Recreational angling for Willamette spring chinook salmon below the Falls is a very popular and significant economic fishery for the region. Sport harvest below the Falls averaged 16,700 fish in the 1970s and 16,800 fish in the 1980s. Similar recreational harvest rates were documented from 1990 to 1996. In 1996, restricted fish resource regulations were imposed. Harvest levels dropped to a range of approximately 1,800 fish in 1997 to 8,700 in 2000 (Foster 1998). Current fisheries are restricted to harvest of hatchery-reared salmon as identified by external fin clip marks.

Winter Steelhead

Consistent with regional trends for naturally-producing salmonids, Willamette River winter steelhead (*Oncorhynchus mykiss*) populations have declined from historic levels. Steelhead populations below the Falls are included in the lower Columbia River ESU. In 1998 and 1999, respectively, steelhead populations in the Willamette River below and above the Falls were listed as threatened under the ESA.[8,9] Subsequent to the

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[6] 64 FR 41835 (August 2, 1999).
[7] 68 FR 55900 (September 29, 2003).
[8] 63 FR 32996 (June 17, 1998).
[9] 64 FR 41835 (August 2, 1999).

listing under the ESA, NOAA Fisheries withdrew its critical habitat designations for steelhead within the Project area.[10] Willamette Falls listed as threatened under the ESA Winter steelhead populations in the Willamette River are heavily influenced by hatchery programs. ODFW fish ladder counts of combined natural and hatchery-origin fish have averaged 12,442 (range 1,800 in 1996 to 26,600 in 1971). Counts since 1990 have been consistently less than 7,200 fish.

Natural populations of winter steelhead in the Willamette have been augmented by hatchery production since the 1960s to provide additional angling opportunities. Most hatchery releases have been curtailed since the ESA listings. In 2000, small numbers of surplus adult winter steelhead were released into the Big Cliff Reservoir, a Corps project located on the Santiam River upstream of the Willamette Falls Project.

Steelhead (primarily winter run) sport harvest below Willamette Falls averaged 414 fish from 1980 to 1996 (Foster 1998). Some of these harvested fish are caught by anglers fishing for spring chinook salmon in late spring or in upriver tributaries during October to December.

Bull Trout

In 1999, bull trout (*Salvelinus confluentus*) was listed as a threatened species under the ESA.[11] While they have not been documented near the Project, 26 populations of bull trout are known to exist in the Willamette Basin. Four existing populations closest to the project are in the McKenzie River and in the middle fork of the Willamette River (Altman *et al.* 1997). The McKenzie River joins with the Willamette River approximately river mile (RM) 148 above the Project. Although generally considered depressed, specific estimates of bull trout abundance are unavailable. Downstream of the Project, the historical populations in the lower Willamette River tributaries and in the Clackamas River are believed to be extirpated (Kostow 1995; Altman *et al.* 1997).

Bull trout are not stocked in the Willamette River and existing populations are legally protected from harvest. State and federal fisheries managers are in the process of developing a bull trout recovery plan.

Coastal Cutthroat Trout

Naturally reproducing coastal cutthroat trout (*O. clarkii*) populations below Willamette Falls were proposed to be listed under the ESA in 2000; however, in June 2002, the FWS withdrew its proposed listing for this species in the Project area.[12] The ODFW lists the status of coastal cutthroat trout statewide as critical (Altman *et al.* 1997).

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[10] 68 FR 55900 (September 29, 2003).
[11] 64 FR 58910 (November 1, 1999).
[12] 67 FR 44934 (July 5, 2002).

Although the anadromous and adfluvial populations are thought to have declined from historic levels (Kostow 1995, Johnson *et al.* 1999), estimates of population abundance in the Willamette River are not available. Freshwater populations of resident cutthroat upstream of the Falls are considered abundant, on the order of tens to thousands of fish per mile (Kostow 1995).

Coho Salmon

Although currently only a candidate for federal listing under the ESA,[13] coho salmon in the Clackamas River is listed as endangered by the state of Oregon. The existing natural population in the Clackamas River is thought to represent a unique population and is considered a unique gene conservation group (Kostow 1995).

Other Native Anadromous Species

White Sturgeon

White sturgeon (*Acipenser transmontanus*) are endemic to the Willamette River below the Falls and in the Columbia, Snake, and Rouge rivers (Kostow 1995). An introduced population of white sturgeon also occurs above the Falls up to Dexter, Oregon (RM 176) (Kostow 1995). No data on population abundance are available.

Downstream of the Falls, white sturgeon were common in gillnet catches from 1987 to 1990, especially in undeveloped shorelines with sandy substrates (Farr and Ward 1993). Since 1989, 58,672 white sturgeon juveniles have been stocked upstream of the Falls to supplement natural populations (Foster 1998). Yearling white sturgeon have been released approximately 215 km upstream of the Project at Harrisburg, Oregon since 1993. These fish are thought to move downstream after stocking and occupy preferred habitats in the Newberg Pool (RM 38.5 to 50.0). Sampling in the Willamette River upstream of the Project indicates white sturgeon reach the legal harvest size of 42 in. Some of these hatchery juveniles have been captured in the fish bypass evaluator station at the T.W. Sullivan development.

Most sturgeon harvest in the Willamette River occurs downstream of the Falls. Angler trips have averaged 6,000 per year for white sturgeon in the lower Willamette River (ODFW 2001). Annual harvests have averaged 1,600 fish from 1986 to 1996. In spring harvest periods, an average of 307 sturgeon were caught from 1980 to 1998, with a range between 71 and 639 fish. Commercial or Tribal harvest of white sturgeon in the Willamette River does not occur, but commercial harvest does occur in January and February at the mouth of the Columbia River, which presumably affects sturgeon abundance below the Falls.

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[13] FR 60 38011 (July 25, 1995)

Pacific Lamprey

Pacific lamprey (*lampetra tridentata*) are a species in a primitive class of anadromous fish that lack true fins, jaws, or bones. Lamprey have skin with no scales, a cartilaginous body, grow as long as 30 inches, and can weigh over a pound.

Lamprey occur from Baja California, to the Bering Sea in Alaska and Asia. Adult lamprey migrate up freshwater rivers typically from July to October. Spawning takes place the following spring when water temperatures are between 50 and 60 degrees Fahrenheit. Lamprey build redds, or nests in streams and rivers and die a few days after spawning. As many as 100,000 eggs take approximately 2 to 3 weeks to hatch. These larval lamprey (ammocetes) then swim out of the nest and seek low velocity backwater areas where soft sediments, mud or detritus are the predominant substrate. The Ammocetes burrow into the muddy bottom where they filter feed on microscopic plant and animal life for 4 to 6 years. The ammocetes go through a 2 month metamorphosis into the adult stage and emerge from the mud averaging 4 to 5 inches in length. The young adult lamprey migrate to the ocean in the late winter or early spring during high flow periods. During the adult ocean phase of Pacific lamprey, they feed as scavengers, parasites or predators on marine fishes and mammals. After 2 to 4 years in the ocean they return to freshwater to spawn.

Pacific lamprey populations are widespread in Oregon coastal basins and in the Willamette, Columbia, and Snake rivers. Lamprey are not listed under the ESA, but they have been listed as "sensitive-vulnerable" species in Oregon because of the widespread perception that lamprey populations in coastal rivers are declining (Kostow 1995). The overall abundance of Pacific lamprey in the Willamette River is not known.

Adult Pacific lamprey have been harvested at Willamette Falls for bait, consumption, commercial, and for traditional Tribal purposes (ODFW 2001). Harvest continues each year to varying degrees dependant on ODFW regulations. In previous years, harvest has occurred between June and the end of August. Commercial harvests have ranged from 9,000 to 34,000 fish during 1990 to 2000. Permits are issued by ODFW for lamprey harvest; the number of harvest permits fluctuates annually, and commercial harvest was not allowed in 2002. During the harvest season, ODFW visually monitors harvest practices at Willamette Falls. Most of the harvest occurs around the time that the flashboards are installed at the Project in early summer.

Juvenile Pacific lamprey moving downstream through water intakes at dams may encounter fish screening systems designed to enhance juvenile salmonid passage. Salmonids are considered strong swimmers, whereas lampreys are considered weak swimmers based on studies of swim speed performance (Dauble and Moursund 1999). The weak swimming ability may have led to impingement of lamprey on extended submerged bar screens (ESBS) documented at the Corps' The Dalles and McNary dams on the Columbia River. The fish screen installed at Unit 13 of the T.W. Sullivan

development differs in many respects from the intake screen systems and bypass at The Dalles and McNary dams.

Downstream movement of juvenile Pacific lamprey at Willamette Falls may comprise two life stages based on research by Beamish and Levings (1991) in the Fraser River system, Canada. They found both older ammocoetes and young adults (post-metamorphosis) moving downstream through the lower reaches of a Fraser River tributary. However, both life stages were represented within the same general size range of 100 to140mm. Both life stages also may move during fall and the following spring, with ammocoetes more prevalent than young adults during the fall.

Available Willamette River juvenile lamprey downstream passage data generally agrees with that reported by Beamish and Levings (1991). Observations by ODFW fish counters in the Willamette Falls ladder described small "juvenile" lamprey in the ladder during November and December (Normandeau 2001). Available data from the T.W. Sullivan evaluator suggests both pre- (ammocoete) and post-metamorphosis (young adult) lamprey, estimated at about 150 mm, occur from fall through spring. Juvenile lamprey counts at the T.W. Sullivan evaluator in 2001 to 2002 were 675 in the spring, 176 in the fall, 260 in the winter, and 34 in the spring of 2002 (Domina 2002).

Juvenile lamprey exhibit diel migration patterns. Most movement occurs at night, and juveniles generally attach and remain on the substrate during the day. Research has also shown that downstream movement of young adult lamprey occurs deeper in the water column than for juvenile salmonids (Long 1968, cited in Dauble and Moursund 1999).

Because lamprey are important both culturally and commercially, this species has been the subject of increasing research attention in the Willamette River by ODFW and the applicants.

Introduced Anadromous Species

Fall Chinook Salmon

Hatchery-origin fall chinook salmon were released in the Willamette River from 1964 to 1994 with the hope of developing a self-sustaining population and to provide commercial and sport fisheries. Since the fall chinook salmon run is introduced, the population in the Willamette River is not included in the Lower Columbia River or Upper Willamette River ESUs (Myers *et al.* 1999). Fall chinook salmon in the Willamette River have been dependent on natural production to maintain population levels since stocking was discontinued in 1994. During the period 1975 to 1999, counts of adult fall chinook salmon past Willamette Falls averaged 12,272 (range 289 in 1999 to 32,877 in 1975).

Sport catch data indicates that an average of 91 (range: 0 to 147) fall chinook salmon were harvested during 1985 to 1998 in the Clackamas River (ODFW 2001). In the upper and lower Willamette River, an average of 75 (range: 0 to 117) fall chinook salmon were harvested during the same time period (ODFW 2001).

Fall Chinook Fry

Fry size salmonids (≤ 60 mm) are also present at Willamette Falls and are observed in the T.W. Sullivan fish bypass evaluator. Small numbers of fry are observed infrequently during the spring compared to large quantities of juvenile and smolt size fish migrating downstream daily. Fry collection performed in March 2001 to May 2002 yielded an average number of 113 (range 2 in November 2001 to 220 in January 2002).

The fry observed at the evaluator are thought to be primarily fall chinook salmon, not spring chinook salmon. As noted above, fall chinook salmon were introduced above Willamette Falls in 1964. The introduced fish are an early spawning or tule stock. From 1964 to 1994, anywhere from 5 to 12 million hatchery smolts were released each year in the Willamette basin above the Falls. Fall chinook hatchery supplementation was stopped in 1994. The introduction of fall chinook in conjunction with past heavy hatchery supplementation have seeded the Willamette Basin above Willamette Falls with a naturally producing run.

Tule fall chinook pass over Willamette Falls from mid-August through late September with peak passage from early to mid-September (Foster, 1998). Fall chinook spawn and rear in the mainstem Willamette River and its lower tributaries. Spawning occurs shortly after entering fresh water, mainly in mid-September through early October. Egg incubation occurs throughout the fall and winter with sac-fry emergence taking place from December to February. Fall chinook smolt early and migrate downstream to estuaries and the ocean as sub-yearlings, spending very little time in fresh water. The average size of downstream migrant fall chinook observed in the Sullivan evaluator is approximately 90 mm. The peak downstream migration occurs in early May and ranges from April to July.

A summary of the key information for Willamette River fall and spring Chinook salmon populations is presented in table 7.

Table 7. Summary of key information for Willamette River fall and spring chinook salmon population. (Source: staff)

Fall Chinook Salmon	Spring Chinook Salmon
• Fry observed at the T.W. Sullivan evaluator (i.e., at Willamette Falls) are considered to be primarily fall chinook based upon fall chinook life history, behavior and close proximity of spawning areas to Willamette Falls.	• The closest spring chinook spawning areas are 80 miles or more upstream of Willamette Falls in tributaries of the Willamette River. Fry from these natural production areas would not be expected in the vicinity of Willamette Falls.
• Wild fall chinook fry observed at Willamette Falls are not yet considered migratory because of their size and they have not reached the smolt stage yet. These fry size fish can be swept downstream from spawning areas located a relatively short distance upstream of the Falls.	• Any fry size spring chinook present at Willamette Falls have likely been washed downstream from upstream rearing areas due to high spring flows.
• Migratory fall chinook arrive later in the spring, are larger and have started smolting. By late spring and early summer, most fall chinook moving downstream have grown past the fry stage and are larger than 60 mm	• Spring chinook fry at Willamette Falls would be displaced from upstream rearing habitats, are susceptible to predation, and may not have a chance to imprint on natal streams.

Summer Steelhead

Summer steelhead were introduced to the Upper Willamette River Basin, and are not considered to be a portion of the Upper Willamette River ESU (Busby *et al.* 1996). Runs of summer steelhead have been larger than winter steelhead in the Willamette River since 1990. Ladder counts since 1990 have ranged from 6,300 to 15,000 fish. This run of steelhead shares similar life history traits as the winter run, but summer steelhead migrate past the Project from March through October, with peak migration timing in mid-May and June.

Summer steelhead have been stocked in the Willamette River since the late 1960s to enhance sport fishing opportunities. Since that time, however, liberal harvest measures have been implemented to limit natural reproduction because of potential competition with native salmonids. In 2000, a total of 514, 255 summer steelhead smolts were stocked into the Willamette Basin. Most of the artificially propagated summer steelhead were released in the upper Willamette, Santiam, and McKenzie rivers. Summer steelhead harvests in the Clackamas River have averaged 4,054 fish (range: 79 to 4,856) during

1985 to 1998 (ODFW 2001). In the upper and lower Willamette River, summer steelhead sport catch numbers averaged 780 fish (range: 71 to 932) during the same period (ODFW 2001).

American Shad

As an introduced species, ODFW views anadromous American shad (*Alosa sapidissima*) as a low priority species for management, unless they affect the growth or abundance of more desirable species. However, American shad are the most abundant fish in the T.W. Sullivan evaluator, with an estimated 10,000 juveniles passing through the Project daily during the peak migration period. Spent adult shad are often seen in the evaluator. Juvenile passage of American shad through the Willamette River begins in mid-May, peaks in June, and extends until July (ODFW 2001) and often stimulates avian feeding near or within the Project (PGE and BHPC 1998a).

In Oregon City, located a few miles below the Falls, creel surveys reported about 11,000 angler trips for this species per year (ODFW 2001). Harvest numbers since 1996 indicate that more than 42,000 fish were captured, with approximately 23,000 shad released. Estimated angler effort by ODFW since 1996 has been between 10,000 to 21,000 trips. Recent catch rates for American shad are between 4.0 to 5.5 fish/trip.

Native Resident Species

The assemblage of native resident fishes in the Willamette River is dominated by species with broad habitat preferences, such as the northern pikeminnow (*Ptychocheilus oregonensis*) and the largescale sucker (*Catostomus macrocheilus*) (Normandeau Associates, Inc. 2001d). Northern pikeminnow and largescale suckers thrive in main channels of rivers with habitat characteristics similar to the reaches upstream and downstream of Willamette Falls. Other native species that are tolerant of habitat characteristics immediately upstream and downstream of the Project include redside shiner (*Richardsonius balteatus*), peamouth (*Mylocheilus caurinus*), and chiselmouth (*Acrocheilus alutaceus*). Native species with narrower habitat tolerances are less abundant, including the mountain whitefish (*Prosopium williamsoni*) and several sculpin and dace species. In most cases, whitefish, sculpin, and dace species prefer habitats with higher velocities. In all, 22 species of native, non-salmonid resident fishes are documented within or near project waters. Potential effects to these species include changes in habitat from upstream reservoir level fluctuations. Project effects on native resident species are similar in type to those described for anadromous fishes; however, effects would be expected to be of reduced magnitude for fish species that disperse across the Project.

Rainbow Trout

The ODFW lists mainstem rainbow trout as a stock of concern, but considers the stock. Native rainbow trout dominate the mainstem middle fork Willamette River and major tributaries, Fall Creek, North Fork Willamette River, and Salmon and Hill creeks (Kostow 1995). In lower river tributaries such as the Molalla, Santiam, and Calapooia, rainbow trout have a sporadic distribution because of competition from winter steelhead and cutthroat trout (Kostow 1995).

In 2000, about 1.1 million rainbow trout were stocked into numerous lakes, creeks, and rivers within the Willamette River Basin to enhance fishing opportunities. Even with intensive stocking above the Project, resident populations of rainbow trout are not documented within or near the Project. Harvest data for rainbow trout is not available because anglers are not required to report rainbow trout harvest to ODFW.

Mountain Whitefish

Historical surveys indicate mountain whitefish (*Prosopium williamsoni*) occur in low numbers in the Willamette River and in the pool above the Project. Mountain whitefish mainly occur farther upstream in habitats with high water velocities. Although uncommon, observations of whitefish at the T.W. Sullivan fish bypass evaluator have been documented.

Northern Pikeminnow

Northern pikeminnow are endemic to the Willamette River drainage. This resident species is of heightened interest because they have been shown to prey on juvenile salmonids. They occur upstream and downstream of the Falls and are found within the Project area, but their abundance in the Willamette River is unknown. Northern pikeminnow harvest in the Willamette River has not been documented.

Introduced Resident Species

Fisheries management of introduced species in the Willamette River Basin has largely focused on salmonids rather than bass, catfish, and walleye. In 1997, data from the T.W. Sullivan fish bypass evaluator indicated that some resident, introduced fishes are probably well established in the pool above the Project, including bluegill (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieu*), and black crappie (*Pomoxis nigromaculatus*). In addition to these species, walleye (*Stizostedion vitreum*) and channel catfish (*Ictulurus punctatus*) have been documented in the upstream pool area. Walleye likely moved upstream through the locks operated by the Corps. Channel catfish were introduced into the Willamette River from stocking efforts upstream. This stocking effort has been discontinued, but young-of-the-year catfish have been documented passing the Project and therefore these fish probably are reproducing naturally.

Smallmouth Bass

Smallmouth bass are a species of management interest in the Willamette River. Smallmouth bass usually occupy warmer habitats downstream of salmonid rearing areas. They are a popular sport fish and an important component of the recreational fish resources within the Project area, particularly upstream of the Falls. The largest management concern for this species is their potential consumption of salmon smolts during their downstream migration in the spring. It is uncertain what effect, if any, smallmouth bass have on ESA-listed salmon smolts in the Willamette River, but temperature-related behavior studies suggest smallmouth bass are relatively inactive during most of the spring smolt migration period (Daily 1992).

Recreational Fishery

A robust recreational fish resource occurs in the vicinity of Willamette Falls. This was most recently documented in 1988 to 1989 by a statewide angling survey (ODFW 1991). This study showed that angling downstream of the Falls is focused on salmonids and other anadromous species, while resident species such as smallmouth bass and rainbow, brook, and brown trout are targeted more often upstream of the Project. ODFW estimated that each year 16,000 to 19,000 anglers participated in the spring run chinook fish resource in the reach downstream of the Falls (ODFW 1989). These anglers spent an estimated 222,457 angler days in the river, contributing greater than 10 million dollars in trip expenditures annually (ODFW 1989). This fish resource is sustained by hatchery production, which releases about 5 million spring chinook salmon to the Willamette River each year (ODFW 2001). Shad, white sturgeon, and lamprey also are, or have been, harvested below Willamette Falls, but their economic impact to the region has not been quantified.

The statewide angling survey sought to characterize anglers' demographics, participation patterns, and expenditures by management zone, species preference, and water types (ODFW 1991). In that survey, most anglers were male (75.3 percent), between the ages of 45 and 64 (50.2 percent), with median incomes of between $20,000 to 30,000. Anglers had 28 years of fishing experience and took an average of 10 trips annually. In the Willamette River, personal value estimates indicate that resident anglers have an impact of $24.35/day and non-resident anglers contribute $14.45/day. Total catch for the Willamette River management zone in 1989 was 4,863,599 fish, with trout and warmwater species accounting for 87 percent of the total catch. This zone encompasses the river from its headwaters to the confluence with the Columbia River.

Tribal Fishery

The Willamette Falls area has been significant to Native Americans as a fish resource since long before EuroAmerican settlement. Access other than by boat has been limited by industrialization since about 1900. Members of at least four tribes are known

to collect salmon, steelhead and lamprey at the Falls for subsistence and ceremonial purposes. A variety of fishing methods are used to harvest salmonids, while lamprey generally are collected by hand from exposed rocks. River access for fishing has become more difficult for Tribal members as they must compete with increasing numbers of non-Tribal anglers. While management considerations such as this are outside the control of the applicants, consultation is ongoing with identified Tribes to clarify whether or how the Project affects harvest activities.

b. Environmental Impacts and Recommendations:

PGE consulted with the fisheries agencies to develop Protection, Mitigation and Enhancement (PM&E) measures for the Project that would provide PGE the flexibility to improve fish passage at its facilities, while at the same time provide the Willamette Falls Settlement Agreement parties the necessary certainty regarding the level of fish protection that would be achieved. Through the consultation process discussed above, PGE developed a program designed to improve fish passage at the Project, which is outlined in section III B. Action Alternative of this FEA.

The Performance Standards and Goals; Consultation and Decisionmaking (Fish Technical Committee); and PM&E measures are contained in the Settlement Agreement filed February 2, 2004. Exhibit A of the Settlement Agreement contains Proposed License Articles. Several of the Proposed License Articles refer to required measures contained in the Relicensing Implementation Plan (Exhibit B of the Settlement Agreement) and Interim Measures (Exhibit C of the Settlement Agreement). A Monitoring and Evaluation program would ensure that the PM&E measures in the Preferred Alternative would function effectively to meet the performance standards and goals. If the performance standards or goals are not effectively met, future PM&E measures would be implemented using a tiered decisionmaking approach.

Applicants' Proposed Fisheries Preferred Alternative

PERFORMANCE STANDARDS AND GOALS

Performance Standards

Downstream Passage of Salmonids

Juvenile Salmonid Passage through the T.W. Sullivan Powerhouse— The current range of mortality to downstream migrants at T.W. Sullivan is 4.5 to 4.8% direct mortality, plus approximately 1.2-1.3% indirect mortality associated with predation (Normandeau 2001h). Mortality was based on the species-specific FGE, turbine mortality rate, bypass mortality rate, and estimated predation based on turbine or bypass passage.

Proposed License Article 2(a) contains the performance standard levels developed by the fisheries resource agencies for downstream passage of juvenile salmonids at the T.W. Sullivan powerhouse within the Project (table 8). Also listed in table 8 are the corresponding tiers of management actions to be taken as determined by the level of performance standard achieved (see section III B. Action Alternative).

Table 8. Agencies' performance standards for juvenile salmonid downstream passage at the T.W. Sullivan powerhouse.

Smolts > 60 mm in Length		**Fry < 60 mm in Length**		**Actions, to include both PM&E Measures and Monitoring and Evaluation listed in Part III**
Mortality	**Injury**	**Mortality**	**Injury**	
Design performance objective < 0.5 % mortality	Design performance objective < 2 % injury	Design performance objective < 2 % mortality	Design performance objective < 4 % injury	Objective met. No further measures required
Actual mortality > 0.5 % but < 2 % would require additional work to lessen mortality	Actual injury > 2 % but < 4 % would require additional work to lessen injuries	Actual mortality > 2 % but < 4 % would require additional work to lessen mortality	Actual injury > 4 % but < 6 % would require additional work to lessen injuries	• Tier 1 and Tier 2 actions implemented per schedule.
Actual mortality > 2 % would require major operational or structural changes	Actual injury > 4 % would require major operational or structural changes	Actual mortality > 4 % would require major operational or structural changes	Actual injury > 6 % would require major operational or structural changes	• Tier 3 actions implemented as needed and meaningful to improve performance. • Tier 4 actions implemented if performance after Tier 3 items is not satisfactory.

The actions listed in table 8 are categorized into four tiers according to planned timing of implementation and which level of performance standard is being addressed. The components of each tier are specified in Appendix 5 of the Relicensing Implementation Plan, which is required by Proposed License Article 2(b). Proposed License Article 3 would require the licensee to complete the tier 1 measures by January 2005.

Tier 2 measures are to be completed by 2008. At the T.W. Sullivan powerhouse, measurement of downstream passage performance for evaluation, using the standards listed in Table 8, would be initiated after installation of the bypass siphon, the earliest Tier 2 measure. Remaining Tier 2 items would be implemented with an associated performance measurement timeline. If measured performance meets the second level of performance standards specified in Table 8 after Tier 2 items are implemented, no Tier 3 measures would be required. Additional minor improvements, designed to achieve further measurable mortality reduction, would be pursued while the second level of performance standards continues to be met.

If measured performance does not meet the second level of performance standards specified in the Table 8 after Tier 2 measures performance testing is completed, Tier 3 measures would be initiated with appropriate and agreed-to performance testing. Tier 3 implementation would begin no later than 2009 unless agreed to by the Fish Technical Committee (FTC) (see CONSULTATION AND DECISIONMAKING, Proposed License Article 1, below). Performance of Tier 2 measures would guide the Tier 3 implementation (for example, if no fish are passing Unit 12 after Tier 2 measures, installing an Eicher screen in Unit 12 would not improve downstream survival).

If measured performance still does not meet the second-level performance standards specified in Table 8 after Tier 3 implementation, Tier 4 would be initiated. Tier 4 is an open-ended list of options in the event that Tier 3 measures are not sufficient to meet standards. Tier 4 measures would begin not more than 10 years after the new license is finalized unless agreed to by the FTC.

Proposed License Article No. 2(a) would require the licensee to achieve the downstream passage performance standards outlined in table 8. License Article No. 2(b) would require that the components of each tier in table 8, specified in Appendix 5 of the Relicensing Implementation Plan, be implemented by the licensee. The plans for each tier measure would be developed in consultation with the FTC pursuant to Proposed License Article 1. Upon approval of the appropriate Fish Agencies and filing and approval by the Commission, the licensee would implement the plan.

Juvenile Salmonid Passage through the Controlled Flow Structure—PGE would design and operate the controlled flow structure to achieve at least 97 percent survival standard for juvenile salmonids passing the Project via the controlled flow structure. This standard is based on results of juvenile fish survival studies conducted at spillways at mainstem Columbia River dams. Proposed License Article 2(c) would require that the licensee achieve this downstream passage performance standard for juvenile salmonid smolts at the controlled flow structure to be constructed at Willamette Falls as provided in Proposed License Article 9, which would require the licensee to construct the controlled flow structure, implement a multi-year evaluation study, and file reports on the results of evaluations.

Performance Goals

Proposed License Article 2(e) would require the licensee to achieve the performance goals for upstream and downstream passage of Pacific lamprey and adult salmonid migrants at the Willamette Falls Project set out in table 9. Measures to meet these goals would be implemented as outlined in section III. B. Action Alternative.

Table 9. Performance Goals for the passage of Pacific lamprey and adult salmonids at the Willamette Falls Project.

Fish species/lifestage	Type of passage	Performance Goal
Juvenile lamprey	Downstream through the powerhouses	"safe, timely, and effective" qualitative goal without serious injury or mortality
Juvenile lamprey	Downstream over the spillway (cap/falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality: Assumed adequate when the standard for juvenile salmonids is met at the spillway (see Table 8), until appropriate technology is developed to assess lamprey survival over the controlled flow structure
Adult lamprey	Upstream through the Project area	Goal to be developed through PGE funded study described in the license application
Adult lamprey	Downstream at the T.W. Sullivan powerhouse and at the spillway (cap/falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality
Adult salmonids	Upstream through the Project area	"safe, timely, and effective" qualitative goal without serious injury or mortality
Steelhead kelts (i.e., post-spawning adults) and fallback (adult salmonids)	Downstream at the T.W. Sullivan powerhouse and at the spillway (cap/falls)	"safe, timely, and effective" qualitative goal without serious injury or mortality

If a technology-based standard for Pacific lamprey survival and injury avoidance is developed and regionally adopted by the USFWS during the term of the new license, Proposed License Article 2(d) would require the Licensee to adopt such standard, which

shall supersede the performance goal set forth in table 9. If the studies conducted pursuant to Proposed License Article 15 (Adult Pacific Lamprey Program) and Proposed License Article 16 (Juvenile Pacific Lamprey Program) indicate that the T.W. Sullivan Powerhouse does not comply with the newly-adopted technology-based standard, the Licensee shall consult with the FTC pursuant to Proposed License Article 1 regarding measures needed to comply with the standard at the T.W. Sullivan Powerhouse. Within twelve months of the adoptions of such standard, the Licensee would file with the Commission a plan describing the proposed measures to achieve the lamprey survival and injury standard at the T.W. Sullivan Powerhouse. The plan would be prepared after consultation with the FTC pursuant to Proposed License Article 1. Upon approvals by the appropriate Fish Agencies and the Commission, the Licensee would implement the plan. Upon Commission approval, the plan shall become a requirement of the License.

CONSULTATION AND DECISIONMAKING (FISH TECHNICAL COMMITTEE)

Proposed License Article 1 would require the licensee to establish the FTC to ensure that the requirements of the Relicensing Implementation Plan are implemented. NOAA Fisheries, the USFWS, and the ODFW are members of the FTC and are collectively referred to as the Fish Agencies. Where consultation with the FTC and approval by the appropriate Fish Agencies are required, the licensee would also submit the final study plan, report, facility design, or operating or implementation plan to the appropriate Fish Agencies for approval prior to filing with the Commission for approval.

Nothing in PGE's proposed fish passage program is intended or shall be construed to affect or limit any agency or tribe from complying with its obligations under applicable laws and regulation or from considering comments received in any environmental review or regulatory process related to the Project.

PROTECTION, MITIGATION, AND ENHANCEMENT (PM&E) MEASURES

As noted in the performance standards above, PM&E measures to be implemented by PGE at the Project for fish protection are structured in a tiered format. The tiers identify which measures are implemented during the current license period (Tier 1) or immediately after the new license is finalized (Tier 2). If measured performance does not meet the standards identified in table 8 of the performance standards above, Tier 3, and potentially Tier 4, measures would be implemented in consultation with the FTC. Measures that would require structural or operational modifications would need to be approved by the Commission.

Downstream Passage

T.W. Sullivan Powerhouse

Juvenile Salmonids— Proposed License Articles 4(a) would require the licensee to modify the siphon spillway; 4(b and c) develop and implement fish evaluation plan and file study results; 4(d and e) install a PIT tag interrogator system at the unit 13 bypass and the siphon bypass; 4(f) implement a trashrack cleaning system; 4(g) modify discharges of units to eliminate potential aquatic predator habitat; 4(h) reduce the potential for avian predation below the powerhouse; 4(i) modify the outfall of unit 13 to meet NOAA Fisheries' criteria and install a PIT tag interrogator system at this location; and 4(j) develop a new auxiliary water supply for the fish ladder entrance. Proposed License Article 5 would require the licensee to replace turbine runners and, if the runner design is significantly different than unit 8's, conduct mortality testing. Proposed License Article 6 would require the licensee to implement an operation plan for the powerhouse.

Downstream Juvenile Pacific Lamprey— Proposed License Article 17 would require the licensee, in consultation with the FTC, to develop a joint evaluation study program covering juvenile Pacific lamprey. To achieve the goal of safe passage for juvenile Pacific lamprey, the licensee would implement the additional measures identified by these studies to reduce injury and mortality of Pacific lamprey that pass through the T.W. Sullivan powerhouse and over controlled flow structure at the Willamette Falls apex.

Adult Salmonids (Kelts and Fallback)—PM&E measures to protect adult salmonids that would be required by Proposed License Article 2(b) are:

1. Remove several outer headgate trashrack bars on the west (West Linn) end to facilitate downstream passage of adult salmonids that are observed in this area.

2. Assess the condition of adult salmonids that pass downstream through the T.W. Sullivan powerhouse and take measures identified as appropriate to ensure safe and timely passage of these fish.

Willamette Falls

Prior to the start of construction of the controlled flow structure, the licensee would be required to remove approximately 150 feet of flashboards at the apex of Willamette Falls to focus flow there and provide a better downstream route for fish passage (Proposed License Article 8). Within 6 months of completion of the controlled flow structure, the licensee would be required to amend the Powerhouse Operational Plan to provide for operating the controlled flow structure for effectively passing fish over the falls (Proposed License Article 10). Proposed License Article 11 would require the licensee to develop and implement a plan to reduce the potential for avian predation on fish passing over the falls.

Upstream Passage

Willamette Falls Fish Ladder Responsibilities

The present fish ladder at Willamette Falls was constructed by ODFW between 1968 to 1971, and major renovations were made in 1996/1997. While ODFW would continue to hold ownership of the ladder and remain responsible for operation and maintenance of the fish counting station, PGE would assume most of the fishway operations and maintenance (O&M) duties under this preferred alternative, as well as other measures described in this section. Proposed License Articles 12(a, b, and c) would require the licensee to complete structural work and assume maintenance and operation responsibilities of ODFW's fish ladder; 12(d) extend the existing log boom; 12(e) modify the fish ladder as deemed necessary by the results of the lamprey research pursuant to

Proposed License Article 15 (Adult Pacific Lamprey Program); and 12(f) modify the entrance to fish ladder. Proposed License Article 13 would require the licensee to develop and implement a fish ladder operation plan.

Stranding

Proposed License Article 14 would require the licensee to develop and implement a Stranding Management Plan to protect adult salmonids and lampreys at the Falls. If changes to the Standing Management Plan are necessary, they would be developed in consultation with the FTC. The amended plan would then be filed with the Commission for approval.

BLUE HERON POWERHOUSE SHUTDOWN

At the BHPC Powerhouse, salmonid smolts are entrained during turbine operation. Impacts resulting from entrainment include turbine passage mortality and tailrace predation on turbine-passed smolts. The effectiveness of the shutdown period varies by species. Available data suggests 84.5 percent of the combined run (all species and stocks) are protected from entrainment by the present spring shutdown regime with protection ranging from a low of 38.2 percent for wild spring Chinook to a high of 97.9 percent for coho salmon (NAI 2001b). Mortality for those smolts that enter the BHPC powerhouse during operational periods was estimated at 18.7 percent.

Proposed License Article 7 would require the licensee to file a decommissioning plan and decommission the Blue Heron Powerhouse by December 31, 2005.

ANNUAL REPORTING AND ESCALATION

Proposed License Article 18 would require the licensee to file a detailed annual report on the activities of the FTC and on the implementation of the Relicensing Implementation Plan during the previous year. Proposed License Article 19 would require the licensee to escalate the costs and payments identified in the Stranding Management Plan and matching funds to conduct lamprey research pursuant to Proposed License Article 12(d) according to a specified formula.

Staff Analysis

Implementation of the fisheries improvements (trash rack, siphon spillway, unit 12 and 13 discharge modification, trash rack cleaning system, and unit 12 Eicher screen) at T.W. Sullivan development forebay and tailrace would benefit listed spring chinook and steelhead that migrate downstream past the Project. These modifications would also improve passage for steelhead kelts and any adult salmon that may fall back over the Falls after migrating upstream through the fish passage facilities.

Implementing a controlled flow structure at the apex of the Falls would enhance downstream passage and fallback conditions for all listed species that pass over the Falls. Additional focused flows provided to known fish standing locations, by selective flashboard removal, would lessen the stranding potential for any late upstream migrating spring chinook salmon by continuously watering scour pools below the fall.

To the extent that operational shutdowns of the BHPC powerhouse would help provide protection to listed species, fish resources at the Project should be enhanced.

Establishing upstream passage standards for performance goals for adult lamprey and salmonids is not a specific measure that would result in improved passage conditions at the Project. The applicants' tiered approach for making fish passage improvements at the Project allows the FTC to review the monitoring results of implemented measures and make recommendations for future improvements, if necessary. The effectiveness of the passage measures would be based on a consensus of the parties that all reasonable efforts to improve passage at the Project have been made.

Numerous Proposed License Articles measures would require approval by the FTC before the licensee would file them with the Commission, without specifically requiring approval by the Commission. Many of these Proposed License Articles, with references to the Relicensing Implementation Plan and Interim Measures, would result in future modifications of Project structures or operations. Commission approval would be required for these measures. Commission approval would be required for Proposed License Articles 2(a) (Downstream Fish Passage standards); 2(b) (Downstream Fish Passage actions); 3 (Implementation of Tier 1 Measures); 4(d, e, f, g, and i) (T.W. Sullivan Modifications); 5 (T.W. Sullivan Powerhouse Runner Replacements); 10 (Willamette Falls Dam Controlled Flow Structure Operational Plan); 12(d) (Fish Ladder Operation and Maintenance); and 15(a) (Adult Pacific Lamprey Program). Staff recommends that the Commission approve the Settlement Agreement.

c. Unavoidable Adverse Impacts:

Some injury and mortality of all fish species would continue as they migrate through the Project area. The extent of this impact would depend on the effectiveness of the fish passage enhancement measures. The proposed tiered approach to implementing fisheries measures would increase the probability of providing effective fisheries enhancements at the Project.

4. Terrestrial Resources

a. Affected Environment:

Vegetation

The following sections describe terrestrial habitat within the Project boundary. First, with regard to the characteristics of vegetation found in each cover type, and then in terms of the habitat quality of each cover type. Information about unique habitats and threatened, endangered and sensitive plant species is also provided. As described below and depicted in Table 10, Project lands may be divided into the following six habitats: Developed/Barren Land, Park/Residential, Wetland, Riparian Forest, and Upland Shrub. There is an additional 38.9 ac of riverine habitat within the Project boundary (Harza 2001).

Table 10. Vegetation cover types within the Project boundary.

Habitat	Acres	Percent[a]
Developed/Barren	16.7	18.8
Park/Residential	6.6	7.4
Wetland	1.0	1.1
Riparian forest	15.8	17.8
Upland Shrub	9.9	11.1

[a] Percent of total land area within Project boundary, including 38.9 ac of Riverine habitat.

Developed/Barren Land

Vegetation—Lands closest to the Project facilities support very little native vegetation. Areas around the Project buildings, roads and walkways have been landscaped using ornamental species, while the riverbanks in this vicinity are primarily barren bedrock, boulder, and rip-rap. Where pockets of soil have developed in the rock, vegetation is a mix of native and introduced forbs and grasses. This cover type includes approximately 16.7 ac (Harza 2001).

Habitat Quality—Habitat quality in the developed/barren cover type is low because the plant community does not provide significant amounts of food or cover, and daily operations of the Project, the USACE locks, and paper manufacturing facilities result in high levels of machinery noise, vehicle traffic, and human activity. However, buildings, bridges and walkways do contribute elements of structural diversity. They

provide cover, resting and/or nesting opportunities for a number of birds (e.g., swifts, swallows, crows, pigeons, gulls) and mammals (e.g., river otters (*Lutra Canadensis*), muskrats (*Ondatra zibethicus*), bats). The proximity of this cover type to water increases its value, because the distance from cover to foraging opportunities is relatively short for piscivorous or insectivorous species that forage in or over water.

Park/Residential

Vegetation—The park/residential cover type accounts for approximately 6.6 ac of Project land. Several acres of this cover type are occupied by facilities such as parking areas, access drives, and a boat launch. Along the lower Tualatin River north of Weiss Bridge on Pete's Mountain Road, a line of trees remains along the river margin, but understory shrubs and groundcovers have been cleared down to the water's edge for a distance of about 375 ft. The park/residential cover type is a matrix composed of 1) turf grasses with a few large diameter, black cottonwoods (*Populus balsamifera trichocarpa*) and 2) a stand of second-growth red alder (*Alnus rubra*) where the understory has been removed. Although the vegetation is mixed, the park/residential cover type was classified as a single cover type due to the similarity of land management in both areas. This cover type includes a small wetland area at Bernert's Landing, where it provides a drainageway from constructed wetlands north of the parking lot to the Willamette River. This area was not mapped as part of the wetlands cover type due to its small size (less than 0.1 ac). The understory vegetation is characteristic of disturbed, seepy, well-shaded soils within alder stands and includes such species as scouring rush (*Equisetum hyemale*), jewelweed (*Impatiens noli tangere*), and foamflower (*Tiarella trifoliata*) (Harza 2001).

Habitat Quality—Overall habitat quality in the park/residential cover type is low. Structural and species diversity is low, disturbance levels are high, and connectivity within the riparian corridor is interrupted by trails and human activity. However, turf grasses provide foraging areas for small mammals and birds that feed on the ground. Mature cottonwoods along the shoreline in this vicinity provide perching opportunities for raptors, kingfishers (*Megaceryle alcyon*) and songbirds. Second-growth alder along the Tualatin just upstream of Weiss Bridge provides some cover and forage for songbirds.

Wetlands

Vegetation—Project lands include about 1.0 ac of wetland that is located along the Tualatin River at the toe of a steep slope upstream of the Weiss Bridge. Two constructed ponds provide shallow open-water habitat. The ponds are surrounded by palustrine emergent wetlands that are dominated by reed canarygrass (*Phalaris arundinacea*). Some native wetland forbs and grasses, such as cattails (*Typha latifolia*) and mannagrass (*Glyceria* spp.), and hydrophytic shrubs, such as red-osier dogwood (*Cornus sericea sericea*) and Pacific willow (*Salix lucida* ssp. *lasiandra*), are also present. While some of these plants may have volunteered, most shrub species were planted as part of an enhancement project undertaken by the City of West Linn Parks and Recreation

Department (Ken Warner, City of West Linn Parks and Recreation Department, personal communication, 2001). Hydrologic support for the wetlands appears to be provided by both piped and surface run-off from residential development upslope of the wetland. A seasonally high water table and occasional flood flows from the Tualatin may also contribute to wetland hydrology (Harza 2001).

Habitat Quality—Overall habitat quality in the wetlands cover type is moderate. Structural and species diversity is presently low, but would be expected to increase as the shrub layer develops over time. Some elements of structure are provided by second-growth alders and small-diameter snags. Habitat quality is improved by the location of this wetland within a forested portion of Tualatin River floodplain, and by relatively low levels of disturbance. The area is not accessible by vehicle, and foot traffic appears to be minimal. The wetland is likely to provide habitat for raccoons (*Procyon lotor*), muskrats, salamanders (e.g., northwestern salamander *Amybystoma gracile*) and frogs (e.g., red-legged frog *Rana aurora* and Pacific chorus frog *Pseudacris regilla*), garter snakes (*Thamnophis* spp.) and several songbird species. Black swifts (*Cypeseloides niger*), red-winged blackbirds (*Agelaius phoeniceus*), tree swallows (*Tachycineta bicolor*), rufous hummingbirds (*Selasphorus rufus*) and mallards (*Anas platyrhynchos*) were observed foraging in the area during the site visit in June 2000. Bullfrogs (*Rana catesbiana*) were also observed during the site visit.

Riparian Forest

Vegetation—Approximately 15.8 ac were cover-typed as riparian forest (Figure D-13). The most common trees in this cover type are red alder, black cottonwood, Oregon ash (*Fraxinus latifolia*), and bigleaf maple (*Acer macrophyllum*). Douglas fir (*Pseudotsuga menziesii*) and Oregon white oak (*Quercus garryana*) are also present on drier sites. The understory shrub layer is dominated by native species. The most common of these are red-osier dogwood, willows (*Salix* spp.), and salmonberry (*Rubus spectabilis*). Oceanspray (*Holodiscus discolor*), snowberry (*Symphoricarpos albus*), and rose (*Rosa* spp.) are common where soils are drier. Hazelnut (*Corylus cornuta*) and Douglas hawthorn (*Crataegus douglasii*) are scattered in the understory, while Himalayan blackberry (*Rubus discolor*) thickets occur along roadways and in sunny openings. Herbaceous species along roadways are dominated by weedy forbs and grasses. A diversity of native species, such as jewelweed, Douglas aster (*Aster douglasii*), cleavers (*Galium aparine*) and fringecup (*Tellima grandiflora*) is represented in areas that are less disturbed (Harza 2001).

Habitat Quality—Habitat quality is relatively high in the riparian forest cover type, owing to species and structural diversity, interspersion of this type with wetlands and riverine habitat, and fairly low levels of disturbance. The mix of conifers and deciduous trees of different ages, tall and low-growing shrubs, and herbaceous groundcovers provide a variety of nesting and hiding opportunities for species that use different levels of vegetation, and conifers provide year-round cover. The variety of trees

and shrubs provide fruits and mast that are important sources of food for many species from early summer through late fall. A few small openings in these forested areas are dominated by forbs and grasses. These forbs and grasses provide early spring forage, as well as seeds in the summer and fall.

The Willamette and Tualatin rivers provide escape, resting, and forage opportunities for riverine and riparian-associated wildlife. However, the absence of coves, deltas, shallows, side channels or backwaters in this reach of the Willamette limits the abundance of aquatic plants and macroinvertebrates (e.g., crayfish, mollusks, caddisflies, mayflies). Deep water and high velocities also may limit accessibility for a number of species that might otherwise forage along the shoreline. Macroinvertebrates are likely more abundant in the Tualatin than in the Willamette, where shallower water increases accessibility for foraging.

Upland Shrub

Vegetation—Project lands along the Willamette River, adjacent to settling ponds and treatment facilities managed by BHPC and the WLPC, can be characterized as upland shrub. This cover type, which accounts for approximately 9.9 ac, includes a scrub-shrub wetland that is dominated by willows. This wetland is located at the mouth of a small stream that enters the Willamette River just west of the settling pond. Due to its small size (less than 0.1 ac), this area was not mapped as part of the wetland cover type. Trees are scattered and include pine (*Pinus* spp.), spruce (*Picea* spp.), cedar (*Calocedrus* spp.) and redwood (*Sequoiadendron giganteum*), in addition to Douglas fir, cottonwood, alder and ash. Himalayan blackberry dominates this cover type, occurring as a dense and fairly continuous thicket, with a few willows scattered along the river margin (Harza 2001).

Habitat Quality—Himalayan blackberry, the dominant species in the plant community, provides hiding, nesting, and foraging opportunities for small mammals and songbirds. However, overall habitat quality is low, based on the low levels of structural and species diversity. This cover type is composed entirely of "edge" habitat, as it is bordered by the Willamette River on one side and by parking/storage areas and settling ponds on the landward side.

Unique or Sensitive Habitats

Both wetland and riparian habitat are typically considered high-value, unique, or sensitive habitat types (Brown *et al.* 1995, Puchy and Marshall 1993). The level of species and structural diversity in the wetland plant community and transitional areas is often high. Wildlife species diversity and abundance is thought to be higher in riparian habitat than in any other habitat type in western Oregon (Puchy and Marshall 1993). Riparian areas are important in providing foraging opportunities, nesting and denning sites, and daily and seasonal movement corridors for numerous species. Wetland habitat

within the Project boundary is atypical and considered of moderate value due to low levels of species and structural diversity.

Cliffs are also considered a unique habitat type. Cliff microclimates (whether cool and seepy or hot and dry) may support unique plants. Cracks, crevices and ledges provide nesting and denning habitat for a number of species, such as bats, swallows, and raptors. No cliffs are located on Project lands, but cliffs from 50 to 80 ft high border approximately 1,000 ft of the Project boundary at its downstream end. Nearest the Project facilities, vegetation on the cliffs consists of ivy (*Hedera helix*) or a mix of native and introduced shrubs, such as poison oak (*Toxicodendron diversilobum*), mock orange (*Philadelphus lewisii*), Himalayan blackberry and Scot's broom (*Cytisus scoparius*), with scattered forbs and grasses (Harza 2001).

Value of Project Lands as Wildlife Habitat

Wildlife habitat quality on Project lands varies from relatively low in the developed/barren and upland shrub cover types, to moderate in the wetland cover type, to relatively high in the riparian forest cover type. Low structural and species diversity, along with fragmented habitats, are the primary limitations on wildlife habitat quality. The long, narrow configuration of the Project boundary exposes each cover type to the effects of adjacent land use. That is, each cover type is composed primarily of "edge" habitat, without an interior that would otherwise be buffered to some degree from recreation, residential, or industrial use. The presence of four parcels of lands within this narrow strip that are managed for industrial uses (settling ponds) contributes another element of disturbance (Harza 2001).

As a major waterway in western Oregon, the Willamette River is an important movement corridor for species associated with open water habitats, including gulls, ducks, geese, wading birds and shorebirds. Habitat along the river also provides some connectivity for terrestrial species moving through the Willamette Basin and into tributary drainages, but fragmentation and the narrow width of the riparian corridor (not only on Project lands, but upstream and downstream as well) limit this benefit. The presence of major highways and cities (I-205 and West Linn on the west bank, SR 99 and Oregon City on the east bank) on both sides of the river in the Project vicinity further limits connectivity with large, undeveloped blocks of upland habitat (Harza 2001).

As a consequence of these limiting factors, Project lands tend to support species with small home ranges, broad habitat requirements and high tolerance to human disturbance. Project lands also support species associated with riparian and riverine habitat. These species are discussed in more detail below.

Wildlife

The habitat requirements and preferences of wildlife species known to occur or considered likely to occur on Project lands are compared below with the characteristics of habitat available. Many of these mammals, birds, amphibians and reptiles are closely associated with riverine and riparian habitat, while others are common in urban open spaces, residential neighborhoods, and forest edges.

Mammals

Large terrestrial mammals—Terrestrial mammals with large territory requirements are not likely to reside on Project lands. However, black-tailed deer (*Odocoileus hemionus*), coyote (*Canis latrans*) and red fox (*Vulpes vulpes*) may be present at times. These species adapt to a variety of conditions, and could use forested and shrub habitats within the Project boundary (Harza 2001).

Marine mammals—One marine mammal species is seasonally present at the Project. California sea lions (*Zalophus californianus*) may have used the Falls as a foraging area even in prehistoric times, but the first documentation in recent history is from 1975. Their appearance in 1975 may be related to enactment of the Marine Mammal Protection Act (MMPA) of 1972. The California sea lion breeding population is estimated to have increased by 5 to 7 % per year since 1972, and sea lions along the Oregon coast may now number from 5,000 to 7,000 during the peak of the fall migration, at which time adult and subadult males move northward (NOAA Fisheries 1997). The two individuals observed in 1975 quickly disappeared, and no sea lions were observed again until 1992. Since then, they have been regular springtime visitors, and their fishing activity has been monitored annually (NOAA Fisheries and ODFW 1997). Observations of sea lion predation on salmonids in 1996 and 1997 indicated that they were taking from 0.3 to 0.6 salmonids per hour, which could have resulted in a seasonal take of 150 to 300 fish. In 2000, five sea lions were observed fishing this area. During weekly monitoring conducted by ODFW from February 7 through June 7, sea lions were observed to take 141 salmonids and 11 lamprey. In April, when 69 % of the fish were taken, two to three sea lions were observed during almost every visit. Few fish were taken during February or March. During these months, only one sea lion was observed during weekly monitoring visits (ODFW 2000). The date of arrival of each animal varied. The first sighting in 2000 was recorded in February, about four weeks earlier than the first sighting in 1999, and about six weeks earlier than the first sighting in 1998. The length of time each sea lion remained in the area varied from four to 23 days, but sea lions were observed in the vicinity from 15 to 17 days longer in 2000 than in the two previous years.

Surveys conducted by ODFW since 1992 indicate that sea lion predation on spring chinook and steelhead at Willamette Falls may be a significant source of mortality (ODFW 2000). Concerns about sea lions in the Willamette and the lower Columbia River led NOAA Fisheries and ODFW to prepare an Environmental Assessment

addressing alternatives for control (NOAA Fisheries and ODFW 1997). The agencies proposed to use non-lethal methods (e.g., underwater firecrackers, rubber buckshot or game stingers, acoustic deterrents, hazing, capture and relocation) to control sea lion fishing activity at the base of Willamette Falls. Implementation of the proposed action, however, was delayed in order to provide NOAA Fisheries with additional time to develop an integrated strategy for managing marine mammal-fisheries interactions. In February of 1999, NOAA Fisheries recommended that Congress reinstate federal and state authority to remove "problem" animals at specific sites, if non-lethal methods proved ineffective in deterring them from predation on salmonids (NOAA Fisheries 1999). On February 5, 2002, NMFS (now NOAA Fisheries) extended the Letter of Authorization, through June 30, 2006, to the state of Washington for the removal of individually identifiable California sea lions that migrate through the Ballard Locks in Seattle, Washington (Federal Register vol. 67 5256-5258). Following several additional years of monitoring by ODFW at Willamette Falls, the amount of salmonid predation by sea lions was considered not significant (personal communication, Bryan Wright, Marine Predation Biologist, ODFW, Corvallis, Oregon, June 18, 2004).

Furbearers—Several furbearers, including beaver (*Castor canadensis*), muskrat, nutria (*Myocaster coypus*) and river otter, were documented in the vicinity of the Project facilities during surveys conducted in 1997 (PGE 1997). Mink (*Mustela vison*), raccoon and opossum (*Didelphis virginiana*) have been observed, and long-tailed weasel (*Mustela frenata*) may also be present. Habitat conditions (e.g., water velocities, available forage plants, or human disturbance) probably limit the abundance of beaver, muskrat, mink, and nutria. Habitat conditions would be more suitable for river otter, raccoon and opossum (Harza 2001).

Small mammals—Small mammals (rabbits, squirrels, shrews, moles, mice and voles) are typically abundant in riparian habitats (Maser 1998). Several factors are thought to contribute to high use of these habitat types, including high levels of primary productivity, a unique microclimate that is cooler during the summer and warmer during the winter than surrounding terrestrial habitat, and a higher proportion of plants that are succulent through a longer period of the year. Soil type may also be important, since many of these species forage, hide and den underground.

Brush rabbits (*Sylvilagus bachmani*), California ground squirrels (*Spermophilus beecheyi*) and Eastern fox squirrels (*Sciurus niger*) have been observed on Project lands (PGE 1997). The wandering shrew (*Sorex vagrans*), Townsend's mole (*Scapanus townsendi*), Townsend's vole (*Microtus townsendi*), deer mouse (*Peromyscus maniculatus*), and bushy-tailed woodrat (*Neotoma cinerea*) are also likely to occur (Maser 1998). These species are found in both upland and riparian habitats. Introduced species, such as the Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*) are also likely present.

Bats have been observed in the vicinity of the T.W. Sullivan powerhouse, but have not been identified to species. All eight species of bats likely to occur in the Project vicintiy use lakes, ponds or streams for drinking and foraging (Perkins 1987). These species include the big brown bat (*Eptesicus fuscus*), long-cared myotis (*Myotis evotis*), little brown myotis (*M. lucifugus*), Yuma myotis (*M. yumanensis*), California myotis (*M. californicus*), long-legged myotis (*M. volans*), silver-haired bat (*Lasionycteris noctivagans*) and Townsend's big-eared bat (*Corynorhinus townsendii townsendii*).

Birds

Waterfowl—Waterfowl are present within the Project boundary year-round. Numbers are highest during the fall and winter (PGE 1997). Few species are likely to nest on Project lands. Mallards and Canada geese (*Branta canadensis*) are common and have been observed with broods. Common mergansers (*Mergus merganser*), buffleheads (*Bucephala albeola*) and wood ducks (*Aix sponsa*) have been observed during the summer, but nesting opportunities for these species, which nest primarily in cavities in trees, are limited at the Project (Harza 2001).

Gulls—Several species of gulls may be present within the Project boundary during the winter, but only the ring-billed gull (*Larus delawarensis*) and California gull (*L. californicus*) were documented during surveys conducted in 1997 (PGE 1997). The highest counts occurred during early spring. Ring-billed gulls accounted for most of the sightings, with 100 observed in February and 150 observed in March. Data from gull observations indicate gulls feed primarily on injured or dead salmonid smolts or juvenile American shad within the Project boundary (PGE 1997).

Wading birds and shorebirds—Several other piscivorous birds (in addition to gulls and mergansers) have been observed within the Project boundary. These include the double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*), black-crowned night heron (*Nycticorax nyticorax*), pied-billed grebe (*Podilymbus podiceps*) and western grebe (*Aechmophorus occidentalis*) (PGE 1997). Of these species, great blue herons are most commonly seen, and several rookeries are located along the Willamette River.

Raptors—Red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*) and turkey vultures (*Cathartes aura*) were observed during wildlife surveys conducted in 1997 (PGE 1997), and ospreys (*Pandion haliaetus*) are frequently observed in the spring and summer. One osprey nest, located on Project land just downstream of Bernert's Landing, appeared to be active in both 1999 and 2000, with one adult observed at the nest during June of both years. Another active osprey nest is located on the west bank of the Willamette River about 0.5 miles downstream of Willamette Falls outside of the Project boundary. Bald eagle (*Haliaeetus leucocephalus*) occurrence is discussed in the threatened, endangered, and sensitive species (TES) section. Peregrine falcons (*Falco peregrinus*) were observed near the USACE locks during water quality sampling on two

occasions in the fall of 2000 (B. Torell, Wildlife Biologist, Harza Engineering Company, personal communication, November 11, 2000). Their presence may be attributed to the success of a hacking program instituted by ODFW in 1984. Between 1986 and 1995, a total of 172 peregrines were released in Oregon. By 1996, a total of 32 active sites, including one in the City of Portland, were documented (Marshall *et al.* 1996).

Upland game birds—Rock doves (*Columba livia*) are frequently observed near the Project facilities (PGE 1997). Other upland game birds that may occur within the Project boundary include the band-tailed pigeon (*Columba fasciata*), California quail (*Callipepla californica*), and ruffed grouse (*Bonasa umbellus*). These species would be found in forested and shrub cover types.

Woodpeckers and passerines—A variety of woodpeckers and perching birds are found within the Project boundary as residents, migrants, or winter visitors. Violet-green swallows (*Tachycineta thallasina*) and cliff swallows (*Hirundo pyrrhonota*) are abundant and are commonly seen foraging over the river. Belted kingfishers (*Ceryle alcyon*) are frequently observed perching in trees along the shoreline. Hairy and downy woodpeckers (*Picoides villosus, P. pubescens*), northern flickers (*Colaptes auratus*), scrub jays (*Aphelocoma californica*), Steller's jays (*Cycanocitta stelleri*), black-capped chickadees (*Parus atricapillus*) and common bushtits (*Psaltriparus minimus*) are likely present in upland and riparian forest cover types within and near the Project year-round (Csuti *et al.* 1997), and were observed during June and September site visits. Golden-crowned kinglets (*Regulus satrapa*), ruby-crowned kinglets (*Regulus calendula*), orange–crowned warblers (*Vermivora celata*), and Wilson's warblers (*Wilsonia pusilla*) may also occur on Project lands. Golden-crowned and ruby-crowned kinglets would be most common during the fall and winter. Orange-crowned warbler and Wilson's warbler would be more common during the spring and summer (Harza 2001).

Species that are expected to use all cover types within the Project boundary to some extent include American crow (*Corvus brachyrhyncos*), American robin (*Turdus migratorius*) and European starling (*Sturnus vulgaris*). The Bewick's wren (*Thryomanes bewickii*), dark-eyed junco (*Junco hyemalis*), white-crowned sparrow (*Zonotrichia leucophrys*) and song sparrow (*Melospiza melodia*) are also likely to make use of forest, shrub, and open, grassy areas on Project lands.

Amphibians and Reptiles

Several amphibian species are likely to be present within the Project boundary (Leonard *et al.* 1993; St. John 1987). Species such as ensatina (*Ensatina escholtzii*) and western red-backed salamander (*Plethodon vehiculum*) are entirely terrestrial. Species that are primarily terrestrial but require aquatic habitat for breeding include northwestern salamander (*Amybystoma gracile*), long-toed salamander (*A. macrodactylum*), rough-skinned newt (*Taricha granulosa*), red-legged frog, Pacific chorus frog and western toad (*Bufo boreas*). These species, which are often found in riparian habitat along small

streams or quiet backwaters, or near lakes, ponds and wetlands, may be present within the Project boundary.

Bullfrogs, which are almost entirely aquatic, are fairly abundant in the Willamette Valley, and were observed on Project lands at wetlands along the lower Tualatin during a June 2000 site visit. Native frogs may be present in the same wetland ponds, although bullfrogs compete with and prey on native species (McAllister and Leonard 1997).

Reptiles that potentially occur on Project lands include rubber boa (*Charina bottae*) and several garter snake species, including western terrestrial garter snake (*Thamnophis elegans*), northwestern garter snake (*T. ordinoides*), and common garter snake (*T. sirtalis*) (Brown *et al.* 1995; St. John 1987). All of these are strongly associated with riparian habitats. Gopher snakes (*Pituophis catenifer*) may also be present, and could make use of drier habitats as well as areas close to the river.

Other reptiles that may be found within the Project boundary include northern alligator lizard (*Elgaria coerulea*), southern alligator lizard (*E. multicarinata*), and western skink (*Eumeces skiltonianus*), although the two latter species are more often found in drier uplands.

Painted turtles (*Chrysemys picta*) and northwestern pond turtles (*Clemmys marmorata marmorata*) may occur on Project lands, but suitable habitat (lakes, ponds or slow-moving waterbodies with large amounts of aquatic vegetation and emergent boulders or logs that provide basking spots) is limited. Three painted turtles were documented approximately 4 mi from the Project in 1991 (ONHP 1999b). An occurrence of northwestern pond turtle, a federal species of concern, was documented in 1984 in Oregon City, but site-specific information is not available (ONHP 1999b).

b. Environmental Impacts and Recommendations:

Issue Statement—Terrestrial Resources and Habitats

As a major waterway in western Oregon, the Willamette River is an important movement corridor for species associated with open water habitats, including gulls, ducks, geese, wading birds and shorebirds. Habitat along the river also provides some connectivity for terrestrial species moving through the Willamette Basin and into tributary drainages, but fragmentation and the narrow width of the riparian corridor (not only within the Project area, but upstream and downstream as well) limit this benefit. The presence of major highways and cities on both sides of the river (I-205 and West Linn on the west bank, SR 99 and Oregon City on the east bank) in the Project vicinity further limits connectivity with large, undeveloped blocks of upland habitat.

Project lands provide a variety of habitats for wildlife species associated with riparian habitat and residential/rural settings. These are species that can make use of

forest edges and shrubby openings, have small home ranges, and are relatively tolerant of disturbance. Ongoing operation of the Project does not appear to directly affect most wildlife use of Project lands, because Project facilities are centralized at one end of the Project area, and no additional lands are needed for operation, maintenance, or access.

Ongoing use of Project lands does have indirect effects on wildlife. Indirect effects on Project lands above the Falls include habitat loss, fragmentation and disturbance resulting from industrial use. The impact of these land uses on wildlife does not appear to be substantially different from impacts that are occurring on adjacent ownerships, and throughout the lower Willamette basin. As described above, conversion of bottomland forest habitat to a heavily populated residential/commercial/industrial setting has altered the composition of the wildlife community and limited wildlife use to those species that can adapt to the changes.

Recreation impacts on wildlife below the Falls appear to be minimal. The rock and rip-rap shoreline and sparse vegetation along the river within the Project boundary do not provide suitable nesting or denning habitat for waterfowl or furbearers found in the Project area, but fishing and boating could cause some disturbance to foraging birds and mammals. Recreation is not likely to affect California sea lions foraging at the base of the Falls. Based on their behavior at other preferred foraging areas (e.g., Hiram Chittenden Locks in Seattle, Washington), sea lions are not easily disturbed by even the most focused and intensive efforts to discourage their presence.

The Project influences river stage elevations upstream as far as Newberg (RM 56). Flashboards are installed atop the concrete cap at the Falls during the low-flow period. The flashboards are usually installed in July and remain in place until at least September, holding the river surface elevation behind Willamette Falls at or above 54 ft rather than at 52 ft MSL during the middle to late growing season.

Installation of the 2-foot high flashboards causes an increase in surface elevation that inundates soils that would otherwise be exposed during several weeks of the late summer and early fall. If the increase occurred early in the season, it could prevent establishment of vegetation along the shoreline in the 2-foot inundation zone. However, the seasonal hydrograph appears otherwise "normal" (i.e., high flows during the late fall and winter as a result of heavy precipitation; spring freshets as a result of snowmelt at higher elevations; and gradually trending downward to low flows during the dry summer and early fall months). Plants would be establishing early in the growing season in zones along the shoreline where soil moisture is suitable. Flows would gradually drop through late spring-early summer, as they would do under "natural" circumstances, before returning in July or August (with installation of the flashboards) to the same levels they had been a month earlier. The effect would be to shorten the low-flow period. In the Project area and further upstream, riparian vegetation is dominated by species (alder, cottonwood, willow, dogwood, salmonberry) that can tolerate a variety of moisture

conditions, including brief winter flooding and low summer flows. Thus, the direct impact of Project operation on vegetation is expected to be minor.

Riparian habitat in the Project area is similar to riparian habitat upstream; it is performing several functions at what might be considered a low to moderate level, but these functions do not appear to be limited by operation of the Project for hydropower. Instead, the limits appear to be a result of previous land use practices (clearing of bottomland forests for agriculture, municipal development, and industry; construction of roads and buildings) and current management of adjacent lands for recreation, residential development, and sewage and industrial wastewater treatment. Some riparian habitat functions could be improved, but multiple uses and the location of the Project in a rapidly urbanizing area may limit the potential for enhancement.

In summary, specific terrestrial issues include:

- Project effects on wildlife resources, including nesting birds, avian piscivores, and marine mammals.
- Project effects on wildlife habitat, particularly the riparian areas inside the Project boundary on the west side of the Willamette River. This includes both operational effects and effects of development and recreational enhancements.
- The potential effects of Project operations on riparian habitat within the Project pool.

Because these terrestrial issues are closely interrelated, they are addressed below in a single analysis.

Effects of T.W. Sullivan Forebay and Tailrace Measures (Tiers 1, 2 and 3)

Construction of facilities to improve downstream fish passage would not affect terrestrial wildlife habitat (assuming staging is done from existing paved areas). However, noise associated with construction may temporarily disturb ospreys (which nest in the vicinity), peregrine falcons, great blue herons, green herons, cormorants, grebes, gulls and other wildlife that forage in the vicinity of Willamette Falls or inhabit the riparian forest. Timing restrictions to protect breeding birds (osprey in particular) during construction would help maintain wildlife use. Installation of an Eicher Screen in Unit 12 would occur entirely within the T.W. Sullivan powerhouse, therefore no terrestrial habitat or species would be affected by construction of the Eicher screen.

Operation of the proposed forebay measures would not affect terrestrial wildlife habitat. None of the proposed alternatives affect water quality or pool elevation. Wildlife may potentially be temporarily impacted by alteration in the frequency and noise level of maintenance activities. It is unlikely, however, that disturbance would be measurable above existing levels.

Foraging opportunities for piscivores may potentially be reduced during salmonid outmigration due to improved forebay flow conditions that may improve fish guidance efficiency and reduce turbine injury and mortality. A change in cul-de-sac flow patterns that eliminate the current turbulent back eddies may further reduce smolt availability to avian predators. However, impacts to avian piscivores, primarily gulls, are expected to be minimal.

The installation of a new bypass route into the north or south siphon and the proposed measure to modify the discharge hydraulics of Units 12 and 13 may potentially create false attraction for upstream migrants along the north side of the cul-de-sac. Any impediments to upstream migration may increase foraging opportunities for sea lions. Non-lethal methods are currently used to deter sea lion fishing activity. Other "removal" methods can be used for problem animals at specific sites if non-lethal methods prove ineffective. If sea lion predation becomes problematic and lethal methods are used, a few individual sea lions may be lost.

Effects of Blue Heron Paper Company Shutdown

There would be no adverse affects on terrestrial resources associated with the proposed BHPC shutdown.

Effects of Modifications to Dam

Proposed measures would create an opening in the dam and flashboards at the apex of the Falls with a flow control structure. Construction would not affect terrestrial wildlife habitat (assuming staging is done from existing paved areas). However, noise associated with construction may temporarily disturb ospreys, great blue herons, green herons, cormorants, grebes, gulls, mallards, Canada geese, furbearers and other wildlife that forage in the vicinity of Willamette Falls. Effects on gulls would be similar to those described in T.W. Sullivan measures.

Effects of Recreation and Cultural Resource Measures

There would be no adverse affects on terrestrial resources associated with the proposed recreation and cultural resource measures.

c. Cumulative Effects:

Industrial, commercial, residential and recreational land have over time, limited riparian habitat functions in the Project vicinity, and have resulted in the loss and fragmentation of wildlife habitat, including riparian habitat. Proposed recreational options or modifications to the Project will result in a relatively minor additional disturbance, loss and fragmentation of habitat.

d. Recommendations:

Staff assess that Project impacts on wildlife are minimal. No measures are proposed.

e. Unavoidable Adverse Impacts:

Unavoidable adverse impacts of fish passage options are primarily limited to minor disturbances during construction. Unavoidable adverse impacts of recreational options are limited to relatively minor disturbance, loss and fragmentation of habitat.

5. Threatened and Endangered Species

a. Affected Environment:

Threatened, Endangered and Sensitive (TES) Fish Species

Four fish species native to the Willamette River are federally listed under the ESA: spring chinook salmon, winter steelhead, bull trout, and Oregon chub. Clackamas River coho salmon are a candidate for federal listing and are listed under the Oregon Endangered Species Act. A brief synopsis of each species' status and their potential for occurrence in the Project area follows. More detailed descriptions of these species can be found in the Fisheries Resources section.

Oregon Chub

Oregon chub were listed as endangered under the ESA in 1993.[14] The current species range in the Willamette River is restricted to several reaches in the upper Willamette Basin well above the Project boundary. No critical habitat has been designated for this species. An interagency agreement between ODFW, Oregon Parks and Recreation Department (OPRD), USFWS, USACE, USFS, and USBR includes plans to protect habitat for conservation of this species and introduce new populations in available habitats (Kostow 1995).

Spring Chinook Salmon

In 1999, spring chinook salmon populations upstream (upper Willamette ESU) and downstream (lower Columbia ESU) of Willamette Falls were listed as threatened under the Endangered Species Act.[15] During both juvenile and adult migrations, spring chinook salmon pass through the reach of the Willamette River within the Project area. NOAA Fisheries has withdrawn the designation of critical habitat.[16]

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[14] 58 FR 53800 (October 18, 1993).

[15] 64 FR 41835 (August 2, 1999).

[16] 68 FR 55900 (September 29, 2003).

Winter Steelhead

In 1998 and 1999, respectively, winter steelhead populations in the Willamette River below and above Willamette Falls were listed as threatened under the ESA.[17,18] During both juvenile and adult migrations, winter steelhead pass through the reach of the Willamette River within the Project area. Subsequent to the listing of theses stocks under the ESA, NOAA Fisheries withdrew its critical habitat designations for steelhead with the Project area.[19]

Bull Trout

In 1999, bull trout were listed as a threatened species under the Endangered Species Act.[20] Bull trout were thought to have historically occurred throughout the Willamette River Basin, but are presently only in the upper McKenzie River Subbasin (PGE 2003). Downstream of the Project, the historical populations in the lower Willamette tributaries and in the Clackamas River are believed to have been extirpated (Kostow 1995; Altman *et al.* 1997). USFWS (2002a) published a proposed rule for bull trout critical habitat in November 2002. Upper tributaries of the Willamette River Basin are proposed as bull trout critical habitat.

Cutthroat Trout

Naturally reproducing coastal cutthroat trout populations below Willamette Falls were proposed to be listed under ESA (65 FR 53974) in 2000. However, in July 2002, the USFWS (2002b) submitted a letter of withdrawal to list them.[21] ODFW lists the status of coastal cutthroat trout statewide as critical (Altman *et al.* 1997).

Collections at the T.W. Sullivan bypass evaluator indicates limited occurrences of cutthroat trout passing the Project (PGE, unpublished data).

Coho Salmon

Although currently only a candidate for federal listing, coho salmon in the Clackamas River are listed as endangered by the State of Oregon.[22] The state listed population is considered a unique gene conservation group (Kostow 1995). Behaviorally, the coho populations in the Clackamas River exhibits different migration patterns and spawn timing, and exhibits a different ocean distribution than coho salmon in other

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17 63 FR 32996 (June 17, 1998).
18 64 FR 41835 (August 2, 1990).
19 68 FR 55900 (September 29, 2003).
20 64 FR 58910 (November 1, 1999).
21 67 FR 44934 (July 5, 2002).
22 60 FR 38011 (July 25, 1995).

Columbia River populations. Coho salmon have the potential to enter the Project area if they stray above the Clackamas River during their adult return migration.

Threatened, Endangered and Sensitive (TES) Wildlife Species

Information provided by USFWS (July 1999, July 2001) indicated that only one federally listed wildlife species, the bald eagle (*Haliaeetus leucocephalus*), is likely to occur in the Project area. Federal species of concern possibly occurring in the Project area include seven mammals, five birds, two amphibians, and one reptile. These animals are shown in Table 11, below.

Table 11. Animals identified by U.S. Fish and Wildlife Service in July 2001 as listed species or species of concern, possibly occurring in the Project area.

Scientific Name	Common Name	Federal Status
MAMMALS		
Corynorhinus townsendii townsendii	Pacific western big-eared bat	SoC[a]
Lasionycteris noctivagans	Silver-haired bat	SoC
Myotis evotis	Long-eared myotis	SoC
Myotis thysanodes	Fringed myotis	SoC
Myotis volans	Long-legged myotis	SoC
Myotis yumanensis	Yuma myotis	SoC
Thomomys bulbivorus	Camas pocket gopher	SoC
BIRDS		
Coccyzus americanus	Yellow-billed cuckoo	SoC
Eremophila alpestris strigata	Streaked horned lark	SoC
Haliaeetus leucocephalus	Bald eagle	LT[b]
Icteria virens	Yellow-breasted chat	SoC
Pooecetes gramineus affinis	Oregon vesper sparrow	SoC
Progne subis	Purple martin	SoC
AMPHIBIANS AND REPTILES		
Clemmys marmorata marmorata	Northwestern pond turtle	SoC
Rana aurora aurora	Northern red-legged frog	SoC
Rana pretiosa	Oregon spotted frog	C[c]

[a] SoC = Species of Concern

[b] LT = Threatened species

[c] C = Candidate species

Federal species of concern that may occur in the Project area include several species of bats, streaked horned lark (*Eremophilia alpestris strigata*), yellow-breasted

chat (*Iteria virens*), purple martin (*Progne subis*), and red-legged frog (USFWS 2001). Existing habitat for these species is limited in quality and quantity, but they may make use of Project lands for foraging.

A recent review of the ONHP database indicated that a total of 33 TES wildlife species, including those shown in Table 11 above, are known or suspected to occur in Clackamas County (ONHP 2001). Table 12 indicates the federal, state and ONHP status for each of these species.

Table 12. Threatened, endangered and sensitive wildlife species documented or possibly occurring in Clackamas County.

Scientific Name	Common Name	Federal[a]/ State[b]/ ONHP[c] Status	Habitat Associations	Likelihood of Occurrence
MAMMALS				
Corynorhinus townsendii townsendii	Pacific western big-eared bat	SoC/SC/2	conifer forest, caves, buildings, bridges, other structures	possible
Lasionycteris noctivagans	Silver-haired bat	SoC/SU/4	conifer forest; uses snags and buildings, bridges and other structures	possible
Myotis evotis	Long-eared myotis	SoC/SU/4	conifer, deciduous and riparian forest; forages over streams, lakes, ponds and pastureland; uses snags, buildings, other structures, caves	possible
Myotis thysanodes	Fringed myotis	SoC/SV/2	conifer forest; forages over lakes, ponds, pasture/meadow; uses snags, buildings, other structures, cliffs and caves	possible
Myotis volans	Long-legged myotis	SoC/SU/4	conifer, deciduous and riparian forest; forages over lakes, ponds, pasture/meadow; uses snags, building, caves	possible
Myotis yumanensis	Yuma myotis	SoC/---/4	conifer and riparian forest; forages over streams, lakes, ponds, marshes, meadows and open space; uses snags, buildings, bridges	possible
Sciurus griseus	Western gray	---/SU/3	oak woodland, conifer and	possible

Scientific Name	Common Name	Federal[a]/ State[b]/ ONHP[c] Status	Habitat Associations	Likelihood of Occurrence
	squirrel		deciduous forest	
Thomomys bulbivorus	Camas pocket gopher	SoC/---/3	Grasslands, agricultural lands and roadsides	possible
BIRDS				
Agelaius tricolor	Tri-colored blackbird	SoC/SP/2	nests in marshes, scrub-shrub wetlands and upland shrub	not likely
Bucephala islandica	Barrow's goldeneye	----/SU/4	nesting known only around high mountain lakes; winters along coast, in Klamath basin, and along Snake and Columbia rivers	not likely [m]
Bucephala albeola	Bufflehead	---/SU/4	nests near high mountain lakes and in artificial nest boxes at lower elevations; found near rivers or other open water outside the breeding season	documented
Chordeiles minor	Common nighthawk	---/SC/4	nests in open areas, forages in a variety of habitats	likely
Coccyzus americanus	Yellow-billed cuckoo	SoC/SC/2	thick closed-canopy riparian forest with dense understory; rare or absent from western US, winters in South America	not likely
Contopus cooperi	Olive-sided flycatcher	SoC/SV/4	uneven-age conifer forest	possible
Dryocopus pileatus	Pileated woodpecker	---/SV/4	primarily conifer forest containing large-diameter snags	possible
Empidonax traillii brewsteri	Little willow flycatcher	---/SV/4	upland and riparian shrub, especially willows	possible
Eremophila alpestris strigata	Streaked horned lark	SoC/SC/2	nests in large open grasslands and pastures	possible
Icteria virens	Yellow-breasted chat	SoC/SC/4	upland and riparian shrub, riparian woodland	likely
Haliaeetus leucocephalus	Bald eagle	LT-PD/LT/2	nests along the coast, major rivers and large waterbodies;	likely

Scientific Name	Common Name	Federal[a]/ State[b]/ ONHP[c] Status	Habitat Associations	Likelihood of Occurrence
			winters where large, concentrated food source present	
Histrionicus histrionicus	Harlequin duck	SoC/SU/2	nesting known only along undisturbed mountain streams; winters along coast	not likely [(m)]
Melanerpes lewisi	Lewis' woodpecker	SoC/SC/4	riparian cottonwood forest and oak/pine woodlands, primarily eastern and southern Oregon	not likely
Podiceps auritus	Horned grebe	---/SP/2	nesting known only in eastern Oregon; winters in coastal waters	not likely [(m)]
Podiceps grisegena	Red-necked grebe	---/SC/2	nesting known only in Klamath and Malheur areas; winters along coast	not likely [(m)]
Pooecetes gramineus affinis	Oregon vesper sparrow	SoC/SC/2	open meadow and pastureland	not likely
Progne subis	Purple martin	SoC/SC/2	open forests and woodlands with snags; nests singly or colonially	likely
Sialia mexicana	Western bluebird	---/SV/4	forest openings and edges, riparian woodlands, open oak woodlands	not likely
Sturnella neglecta	Western meadowlark	---/SC/4	open meadow and pastureland	possible
AMPHIBIANS				
Aneides ferreus	Clouded salamander	---/SU/3	moist conifer or mixed forest	not likely
Bufo boreas	Western toad	---/SV/4	ponds, marshes, streams in meadows and forests	possible
Rana aurora aurora	Northern red-legged frog	SoC/SV/2	ponds, marshes, streams in meadows and forests	possible
Rana pretiosa	Oregon spotted frog	C/SC/1	ponds and marshes at low elevations	not likely
REPTILES				
Chrysemys picta	Painted turtle	-----/SC/2	shallow ponds, lakes and streams with muddy or sandy substrate, abundant aquatic	not likely

Scientific Name	Common Name	Federal[a]/ State[b]/ ONHP[c] Status	Habitat Associations	Likelihood of Occurrence
			vegetation and basking sites	
Clemmys marmorata marmorata	Northwestern pond turtle	SoC/SC/1	shallow ponds, lakes and streams, abundant aquatic vegetation and basking sites in close proximity to open woodlands	not likely

DEFINITIONS

[a] **Federal Status**: LT = Threatened; PD = Proposed for de-listing; SoC = Species of Concern; C = Candidate

[b] **State Status**: LE = Endangered; LT = Threatened; SU = Sensitive Undetermined Status (species for which status is unclear); SV = Sensitive Vulnerable (species for which listing as threatened or endangered is not imminent and can be avoided through protective measures); SC = Sensitive Critical (species for which listing as threatened or endangered is pending or warranted if immediate conservation measures are not taken; SP = Sensitive Peripheral (species on the edge of their range in Oregon).

[c] **Oregon Natural Heritage Program Status**: 1 = taxa threatened with extinction or presumed to be extinct throughout their range; 2 = taxa threatened with extirpation or presumed to be extirpated from the state; 3 = taxa for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon, or throughout their range; 4 = taxa which are of conservation concern but are not currently threatened or endangered.

[(m)] Occasional migrant

Threatened, Endangered and Sensitive (TES) Plant Species

Information provided by USFWS indicated that four federally listed species and five plants considered as species of concern could occur on lands within or near the Project (USFWS 2001). These plants are listed in Table 18, along with their federal and state status. A search of the ONHP database indicated that one federally endangered species and two federal species of concern have been observed within two miles of the Project area (ONHP 2001). These plants are indicated with an asterisk in Table 13.

The Willamette daisy (*Erigeron decumbens var.decumbens*) has not been documented in the Project area since 1894 (ONHP 2001). A small population of white top aster was reported in 1990 at Camassia Natural Area in West Linn. White rock larkspur has also been found in Camassia Natural Area, which is located well outside the Project area. In 1977, white rock larkspur (*Delphinium leucophaeum*) was documented in Oregon City along the Willamette River near a lookout point just upstream of Willamette Falls, and as recently as 1999 on Rock Island, the island north of Rock Island, and the west side of the river near Pete's Mountain Road (ONHP 2001). This plant was

historically documented along the west bluffs of Willamette Falls from 1903 to 1940. In addition to federally listed species, two candidate species for state listing, tall bugbane (*Cimicifuga elata*) and Howell's montia (*Montia howellii*), have also been documented in West Linn, but outside the Project area (ONHP 2001).

A recent review of the ONHP database indicated that a total of 41 species, including those shown in Table 13, were known or suspected to occur in Clackamas County (ONHP 2001). Table 14 shows the federal and state status, The Nature Conservancy (TNC) global and state ranking, and ONHP list identification for these plants. Information obtained through literature review (e.g., Hitchcock *et al.* 1955-1969; Oregon Flora Newsletter; Congressional Federal Register) was used to compare the habitat requirements of plants listed in Table 14 with habitat conditions found in the Project area. Based on elevations, soils, moisture regimes and plant associations where they are typically found, many of the plants listed in these tables are unlikely to occur in the Project area. However, habitat requirements are not always well understood for rare species, so all species in Table 14 were considered as possibly occurring in the Project area.

Field surveys were conducted in June 2000 to investigate the possible occurrence of these plants. The survey was timed to coincide with the time of year when most of these plants could be readily identified. No rare plants were found. During the June survey, habitat potential for later-blooming plants was also evaluated. No suitable habitat was observed that could support such species; therefore, no additional surveys were conducted.

Table 13. Plants identified by U.S. Fish and Wildlife Service as listed, proposed, candidate, or species of concern at the federal level, possibly occurring in the Project area.

Scientific Name	Common Name	Federal Status	State Status
*Aster curtus**	white top aster	SoC	LT
Castilleja levisecta	golden Indian paintbrush	LT	LE
*Delphinium leucophaeum**	white rock larkspur	SoC	LE
Delphinium pavonaceum	peacock larkspur	SoC	LE
*Erigeron decumbens var. decumbens**	Willamette daisy	LE	LE
Lathyrus holochlorus	Thin-leaved peavine	SoC	--
Lomatium bradshawii	Bradshaw's lomatium	LE	LE
Sidalcea nelsoniana	Nelson's checker-mallow	LT	LT
Sullivantia oregana	Oregon sullivantia	SoC	C

* Species documented within 2 miles of the Project boundary (ONHP 2001)

Federal and State Status: LE = Listed Endangered; LT = Listed Threatened; PE = Proposed Endangered; PT = Proposed Threatened; C = Candidate for listing; SoC = Species of Concern.

Table 14. Sensitive plant species known or suspected to occur in Clackamas County (ONHP 2001).

Scientific Name	Common Name	Federal Status	State Status	TNC Global Rank	TNC State Rank	ONHP List
Agoseris elata	tall agoseris	---	---	G4	S1	2
Arabis furcata	Cascade rockcress	---	---	G4	S3	4
*Aster curtus**	white top aster	SoC	LT	G3	S2	1
Calamagrostis breweri	Brewer's reedgrass	---	---	G3	S2	2
Carex livida	pale sedge	---	---	G5	S2	2
Castilleja rupicola	cliff paintbrush	---	---	G2G3	S2	2
*Cimicifuga elata**	tall bugbane	---	C	G3	S3	1
Collomia larsenii, C. debilis var. larsenii	Larsen's collomia	---	---	G5T4	S4	4
Coptis trifolia	three-leaf goldthread	---	---	G5	S1	2
Corydalis aquae-gelidae	cold-water corydalis	---	C	G3	S3	1
*Delphinium leucophaeum**	white rock larkspur	SoC	LE	G2	S2	1
Delphinium nuttallii	Nuttall's larkspur	---	---	G4	S1	2
Delphinium pavonaceum	peacock larkspur	SoC	LE	G1	S1	1
Douglasia laevigata	smooth-leaved douglasia	---	---	G3?	S?	3
Draba aureola	golden alpine draba	---	---	G4	S4	4
Epilobium luteum	yellow willow-herb	---	---	G4?	S?	3
Erigeron cascadensis	Cascade daisy	---	---	G4	S4	4
*Erigeron decumbens var. decumbens**	Willamette daisy	LE	LE	G4T1	S1	1

Scientific Name	Common Name	Federal Status	State Status	TNC Global Rank	TNC State Rank	ONHP List
Erigeron howelli	Howell's daisy	---	C	G2	S2	1
Eriophorum polystachion	many-spiked cotton-grass	---	---	G5T5	S3	4
Euonymus occidentalis	western wahoo	---	---	G3	S3	4
Howellia aquatilis	howellia	LT	---	G2	SH	1-ex
Huperzia occidentalis = *Lycopodium selago*	fir club-moss	---	---	G5	S3	4
Lathyrus holochlorus	thin-leaved peavine	SoC	---	G2	S2	1
Lycopodiella inundata	bog club-moss	---	---	G5	S2	2
Lycopodium annotinum	stiff club-moss	---	---	G5	S2	4
Lycopodium complanatum	ground cedar	---	---	G5	S2	2
*Montia howellii**	Howell's montia	---	C	G3	S2	4
Ophioglossum pusillum	adder's-tongue	---	---	G5	S1	2
Poa laxiflora	loose-flowered bluegrass	---	---	G3	S3	4
Poa marcida	weak bluegrass	---	---	G4	S4	4
Rhynchospora alba	white beakrush	---	---	G5	S?	3
Scheuchzeria palustris var. Americana	scheuchzeria	---	---	G5T5	S2	2
Sidalcea campestris	meadow sidalcea	---	C	G4	S4	4
Sisyrinchium sarmentosum	pale blue-eyed grass	SoC	C	G2	S1	1
Streptopus streptopoides	kruhsea	---	---	G5	S2	2
Sullivantia oregana	Oregon sullivantia	SoC	C	G2	S2	1
Utricularia minor	lesser	---	---	G5	S2	2

Scientific Name	Common Name	Federal Status	State Status	TNC Global Rank	TNC State Rank	ONHP List
	bladderwort					
Vaccinium oxycoccos var. intermedium	wild bog cranberry	---	---	G5	S4	4
Verbena hastata	blue verbena	---	---	G5	S?	3
Wolffia columbiana	Columbia water-meal	---	---	G5	S1	2

* Species documented within 2 miles of the Project boundary (ONHP 2001)

Federal and State Status: LE = Listed Endangered; LT = Listed Threatened; PE = Proposed Endangered; PT = Proposed Threatened; C = Candidate for listing; SoC = Species of Concern (former C2 candidates for which additional information is needed to propose for listing at the federal level under the ESA).

The Nature Conservancy Natural Heritage Network Ranks: G1 = Critically imperiled throughout its range; G2 = Imperiled throughout its range; G3 = Rare, threatened or uncommon throughout its range; G4 = Not rare, apparently secure throughout its range; G5 = Widespread, abundant and secure throughout its range; S1 = Critically imperiled in Oregon; S2 = Imperiled in Oregon; S3 = Rare, threatened or uncommon in Oregon; S4 = Not rare, apparently secure in Oregon; S5 = Widespread, abundant and secure in Oregon; ex = Presumed extirpated or extinct; U = Unknown rank; ? = not yet ranked or assigned rank is uncertain.

Oregon Natural Heritage Program Lists: 1 = Threatened with extinction or presumed to be extinct throughout their entire range; 2 = Threatened with extirpation or presumed to be extirpated from the state (often peripheral or disjunct species; can be very significant when protecting genetic diversity of a taxon); 3 = More information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range; 4 = Of conservation concern, but not currently threatened or endangered.

b. Environmental Impacts and Recommendations:

Issue Statement—Threatened and Endangered Fish Species

Effects of the various enhancement options on listed fish species are described in detail in the Fisheries Resources section. This section contains a brief summary of potential impacts to ESA listed fishes. These include Oregon chub, bull trout, spring run chinook salmon, and winter steelhead.

The current distribution of Oregon chub in the Willamette River is limited to reaches well upstream from the Project. Thus, no impacts are expected on Oregon chub populations. Based on the current distribution of bull trout in the Willamette River Basin,

no impacts are anticipated from the proposed enhancement options. Impacts on chinook and steelhead are discussed below.

Effects of T.W. Sullivan Forebay and Tailrace Measures (Tiers 1, 2, and 3)

The implementation of T.W. Sullivan forebay and tailrace options (trash rack, siphon spillway, unit 12 and 13 discharge modification, rack cleaning system, unit 12 Eicher screen) would significantly benefit listed spring chinook salmon and winter steelhead that migrate downstream through the Project. These options also would improve passage conditions for steelhead kelts and any salmon and steelhead fallbacks, including potential Clackamas River coho salmon strays, which are a candidate for federally listing and are listed under the Oregon Endangered Species Act.

Effects of Modifications to Dam

Implementing a controlled flow structure measure at the apex of the Falls would enhance downstream passage and fallback conditions for all listed fishes that pass over Willamette Falls. Additional focused flow provided to known fish stranding locations, by selective flashboard removal, would lessen the stranding potential for any late upstream migrating spring chinook salmon by continuously watering scour holes.

Effects of Blue Heron Paper Company Shutdown Management Plan Measure

To the extent operational shutdowns of the BHPC powerhouse provide the required protection criteria to listed fish species, the protection of fish resources should be enhanced.

Effects of Recreation and Cultural Resource Measures

Recreation and cultural resource measures have no effect on fish passage, flow or water quality. No impacts to fish resources will result.

Issue Statement—Threatened and Endangered Wildlife Species

Bald eagles are the only federally listed wildlife species occurring in the Project area. There are three known nest sites in Clackamas County, none of which are within the Project boundary. One nest is located upstream of the Project near the mouth of the Molalla River, the second is located downstream of the Project near Lake Oswego, and the third is near Barton on the Clackamas River (Harza 2001). Project lands do not contain suitable nesting habitat and it is unlikely that continued Project operation will have an effect on bald eagles.

Federal species of concern that may occur in the Project area include several species of bats, streaked horned lark, yellow-breasted chat, purple martin, and red-legged frog (USFWS 2001). Existing habitat for these species is limited in quality and quantity,

but they may still potentially use Project lands for foraging, breeding, and shelter at various times throughout the year.

Effects of Downstream Passage, Recreation and Cultural Measures

None of the proposed measures at T.W. Sullivan, BHPC or along the Falls result in a loss of wildlife habitat for TES species within the Project boundary or vicinity. It is unlikely that operations of the proposed actions will affect listed or sensitive species. Construction of facilities to improve downstream fish passage would not affect terrestrial wildlife habitat assuming staging is done from existing paved areas. However, noise associated with construction may temporarily disturb nesting, foraging or migrating birds in the vicinity.

Issue Statement—Threatened and Endangered Plant Species

Vegetation in and near Project land has been affected by a variety of ground-disturbing activities, beginning with conversion of conifer forests to agricultural use in the early 1800's. Development increased through the 19th and 20th centuries, and industrial, commercial and residential uses now dominate the landscape. The long, narrow configuration of Project land near West Linn exposes each cover type to the effects of adjacent land use. Each cover type is composed primarily of "edge" habitat, without an interior that would otherwise be buffered to some degree from recreation, residential, or industrial use. The presence of four privately-owned parcels of land within this narrow strip, that are managed for industrial uses, contribute another element of disturbance. Field surveys were conducted in 2000 to investigate the possible occurrence of TES plants and suitable habitat (Harza 2001). No TES plants were found, nor was suitable habitat observed. Given the absence of suitable habitat and TES plants, ongoing operations will have no impact.

Effects of Downstream Passage, Recreation and Cultural Measures

None of the proposed measures at T.W. Sullivan or BHPC would disturb additional land, assuming all construction staging occurs on existing paved areas. No TES plants or suitable habitat were documented during surveys conducted in 2000 (Harza 2001). Therefore, it is unlikely that any increased use of the area would affect rare or sensitive plants.

c. Conclusions:

Proposed enhancement measures would have no impact on Oregon chub and bull trout and minor impacts on cutthroat trout populations. The proposed measures for fish resources would improve passage conditions, increasing survival of listed salmonids through the Project area. The recreation, and cultural enhancement measures are not expected to have an impact on fisheries resources. Because habitat is limited in quantity

and quality, or non-existent, it is unlikely these TES plant and wildlife species would be affected by any of the proposed measures. Discussion of recommendations is provided in the Comprehensive Development Analysis.

d. Cumulative Effects:

Fisheries resources in the Project area are affected by urban, industrial, and agricultural uses in and around the vicinity of Willamette Falls Project. These land uses have changed the water quality, hydrologic and habitat of the Willamette River, altering the environment to the detriment of listed fish. For example, urban and industrial development has resulted in loss of off-channel habitat that would serve as resting or rearing habitat for downstream migrating spring chinook salmon and steelhead and the presence of millions of hatchery salmonids, released in the system, increases risk for listed salmonids. Hatchery fish can affect natural fish through direct predation competition for food and habitat, and through genetic mixing with native salmonid stocks. Measures that enhance passage and survival for listed fishes would help to alleviate cumulative impacts to listed fishes in Willamette River.

Industrial, commercial, residential and recreational land uses limit habitat function in the Project vicinity, and have resulted in fragmentation of wildlife habitat. Proposed recreational, land use, and cultural measures would result in no additional disturbance, loss or fragmentation of habitat.

c. Unavoidable Adverse Impacts:

Some injury to and mortality of TES fish would continue for those species that migrate through the Project area. The exact level of that mortality will depend upon the eventual performance of the downstream passage measures. No unavoidable adverse impacts are expected for TES wildlife and plants.

6. Aesthetic Resources

a. Affected Environment:

The Project site is centered around a 40-foot-high waterfall created by the Willamette River as it flows over a rocky, horseshoe-shaped basalt reef located in a reach which separates the communities of Oregon City and West Linn. In the Project area, the river passes through a canyon that is approximately 0.4 miles wide and 100 ft deep. As a result of 150 years of development, the Falls and surrounding area have been significantly altered, and large industrial structures are prominently visible elements in this landscape. Despite the industrial nature of the setting and long-standing alterations to the Falls, there are certain constituencies that find the Falls appealing.

Project Area Viewshed

The viewshed, also known as the "seen area", can be defined as 1) all surface areas visible from an observer's viewpoint, or as 2) surface areas from which a viewpoint or critical object can be seen (Smardon *et al.* 1988). For this Project, the primary viewshed of concern is the area from which the T.W. Sullivan and BHPC powerhouses, the Falls, the dam, and the adjacent areas of the river can be seen. It extends within 0.5 miles of the Project features. The foreground zone is the area within which the details and colors of landscape features are most detectable (Smardon *et al.* 1988); views within this distance zone are the ones most sensitive to any visible changes to Project features.

Existing Aesthetic Character

The aesthetic character of the Project area reflects both the natural setting and the effects of over 150 years of urban and industrial development. The unity and intactness of the natural landscape setting has been significantly altered by the urban and industrial development that has taken place since Europeans first settled the area in the 1830's. The buildings of the WLPC, along with the T.W. Sullivan powerhouse are visually dominant features at the base of the Falls on the west side of the river. The large buildings, tanks, and stacks that are a part of the BHPC facility dominate the east bank of the river at the Falls' base. The appearance of the Falls themselves has been modified by the development of structures on portions of the original Falls, and by the construction of dams and fish ladders. One of the most obvious alterations of the Falls' natural appearance is the ODFW fish ladder, which includes large, boxy, concrete structures that are prominently visible. The eastern face of the Falls has been the least affected by these changes, and the southern and western faces most affected.

In 1986, floodlights were installed on the WLPC and BHPC properties to provide illumination that would allow viewers at the Highway 99E and I-205 overlooks to enjoy the Falls at night (Portland Oregonian 1986). When installed, the intent was to operate the lights from dusk until 11:00 PM during the high flow season of October through April or May. In March 2001, a decision was made to discontinue the practice of illuminating the Falls at night because the lighting allowed birds to extend their predation of juvenile fish migrating downstream into the nighttime hours (Dan Domina, PGE, personal communication, 2001).

Key Viewpoints

A set of key viewpoint locations has been identified that provides a representative sampling of visual conditions within the Project area. Criteria for selecting these viewpoints included visibility of the Falls, the dam, and the powerhouse structures; viewing context, numbers of viewers, and view sensitivity. Photos from each viewpoint are included in the Visual Analysis Report (PGE and BHPC 2001a), and are briefly described below.

Highway 99E Willamette Falls Viewpoint and Canemah Walkway: The Highway 99E Willamette Falls viewpoint is located about 500 ft from the Falls on the Oregon City side of the river. From this viewpoint, the impoundment behind the dam is readily visible, and the western and southern faces of the Falls can be seen, while the eastern face is not at all visible. This viewpoint is the view closest to the Falls that is readily available to the public. The most visible portions of the Falls are those that have been most modified and which are covered with water only at higher flows. The intensive industrial development on the west bank of the river is a visually dominant component of this scene.

The Canemah walkway is a pedestrian and bike trail that extends from the Willamette Falls Viewpoint along the west side of Highway 99E, to Canemah, 0.5 miles to the south. From this walkway, there is a series of views of the Falls. Like those from the Highway 99E viewpoint, views from this area provide a good overlook of the impoundment behind the dam and of the Falls' western face, but do not provide views of the Falls' eastern face. In many areas along the walkway, heavy tree cover blocks views towards the river and the Falls.

Museum of the Oregon Territory: The Clackamas County Museum of History occupies a newer three-story building on a bluff near the Highway 99E Willamette Falls Viewpoint. The Museum building, located approximately 700 to 800 ft from the Falls, was designed to provide views toward the Falls from its second floor gallery and third floor meeting room. This view is similar to the one from the Highway 99E overlook.

McLoughlin Promenade in Oregon City: The McLoughlin Promenade is a narrow park strip along the edge of the bluffs above downtown Oregon City. The promenade consists of a paved pedestrian walkway that provides panoramic views of downtown Oregon City, the Willamette River, the Falls, and the industrial facilities around them. The area along the promenade is landscaped, and includes several historical markers. The Oregon City Comprehensive Plan (Oregon City 1982) specifies that vistas from the McLoughlin Promenade on a list of major scenic views and vistas should be preserved. The promenade's distance from the Falls ranges from 0.15 miles to over 0.5 miles. The modified western and southern faces of the Falls are visible, but the eastern face is not.

Oregon City Bridge and New McLoughlin Boulevard Vista Point: Willamette Falls and the BHPC powerhouse are visible from the Oregon City 7th Street Bridge, which crosses the Willamette River at a point 0.66 miles downstream of the Falls. This narrow bridge carries a high volume of traffic and the view toward the Falls is not readily observable by drivers. This view is 90° to the driver's cone of vision and is blocked by the bridge's heavy structural elements. Although the bridge is not considered to be friendly for pedestrians (Ken Warner, West Linn, personal communication, 2001), there is a modest level of pedestrian traffic across the bridge. Pedestrians using the sidewalk on the bridge's south side have an elevated view towards the Falls.

For travelers driving south on McLoughlin Boulevard in Oregon City, there is a view down the river that terminates at the Falls. This view is highly coherent because it lies near the center of the traveler's cone of vision. The sidewalk on the riverside of McLoughlin Boulevard between the bridge and the BHPC complex is an area that has traditionally received heavy use by sport anglers. Oregon City recently completed construction of a scenic overlook providing a view very similar to that seen by pedestrians on the nearby bridge. The Falls are readily visible in the far middleground, and the forested hillsides provide an attractive and natural-appearing backdrop. Only the eastern face of the Falls is readily visible. There is only a small glimpse of the southern face, and the western face is not visible at all.

Adjacent to Substation on West Side of River: A view of the Falls is available from the area adjacent to PGE's substation on Willamette Falls Drive. This area has not been developed for public access, and site conditions suggest that it probably does not receive much public use. The advantage of the view from this area is that most of the Falls' eastern and southern faces are visible, while the fish ladder is not. These faces are the most attractive parts of the Falls in that much of the flow is concentrated in these areas. This viewing location is close enough to permit some experience of the Falls' sounds, and good views of the mist and circling birds. In addition, from this viewpoint, the various mill buildings are to one side and do not dominate the view to the extent that they do in views from the east. From a substantial portion of this area, however, the large steel superstructure formerly used as a part of the WLPC's log handling operation is prominent. City of West Linn Parks and Recreation Department has recognized the potential of this viewpoint and suggests that opportunities to view the Falls should be provided, taking the form of either a viewing platform or a trail (K. Warner, City of West Linn Parks and Recreation Department, personal communication, 2001).

Viewing Area Along Interstate 205: A rest stop and scenic Falls overlook are located along Interstate 205 eastbound. This viewpoint is believed to be used primarily by tourists from outside the area who are traveling east on I-205, rather than by local residents (K. Warner, City of West Linn Parks and Recreation Department, personal communication, 2001). The overlook provides fairly good views of the Falls' eastern face, although they are more distant than those from the area near the substation (0.35 miles from the I-205 vista point vs. 0.20 miles near the substation). From the developed portions of the vista, the angle of view does not permit the southern face of the Falls to be seen. In addition, the fish ladder is not visible from this viewpoint. At present, most of the views toward the Falls from this area are blocked to some degree by the vegetation on the slopes below.

River Below the Falls: Because of the industrial development on both sides of the river, there are no trails or paths that provide public access to base of the Falls. Only those who approach from downstream by boat may experience these views. Several tour boat companies offer seasonal excursions on the Willamette that approach the base of the

Falls. When flows are low enough to be able to approach the Falls, the river provides the most dramatic view of the Falls. The apparent height of the Falls is enhanced and its rocky features can be seen easily at close range. The proximity makes it possible for the visitor to experience the sound made by the rushing water and to see and feel the mist. When flow conditions allow a boat to move into the center of the horseshoe area, the viewer can be surrounded by the Falls on three sides, intensifying the visual and auditory experience.

Aesthetic Character of the Falls

At Willamette Falls, the river has eroded back into the rocky reef forming the Falls to create a long, narrow, rock-walled chute through which the cascading water is channeled. The river flows into this chute in a horseshoe or j-shaped pattern, creating a waterfall with a total crest length of approximately 1,700 ft. Approximately 1,000 ft of the crest is located along the east side of the chute, extending from the BHPC powerhouse to the apex of the Falls. The southern face of the Falls, in the narrow area at the head of the chute, is approximately 200-foot wide. The remaining 500 ft of its crest is located on the west side of the chute in the area between the Fall's apex and the buildings that are part of the WLPC complex.

The appearance of the Falls has been modified to some extent by the Project's dam structure and to a greater degree by the ODFW fish ladder facility. The eastern face of the Falls has undergone the least modification. In this area, the dam is set back from the crest, is relatively low and not visually dominant. Along the southern face of the Falls, the dam is also set back from the crest, and not visually prominent. A large box-like concrete structure that is a part of the fish ladder has been built at the base of the Falls immediately west of its southern face. Consequently, the western face has a highly modified appearance. Here, other large, angular structures associated with the fish ladder extend out from the dam at the crest of the Falls, creating walls that extend straight up from the plunge pool to crest height. These structures are visually prominent at times of low and medium flow.

Over time, the flow of the river has cut a great many channels of varying depth and width into the crest of the Falls. These channels concentrate the flows into specific areas, so that at low flows, the feature appears to be a series of small falls separated by stone buttresses. As flows increase, the individual falls widen, and the intervening rock buttresses become smaller and less visually dominant. As flows become higher, the buttresses are drowned by the cascading water, but the presence of the buttresses creates a curtain of water that is wavy rather than straight, adding a sense of depth and increasing the Falls' level of visual interest. On the western face of the Falls, the natural channelization pattern has been altered by the fish passage structures. At flows over 50,000 cfs, the water curtains formed by the flows have a more regular appearance than those formed by the flows over the other segments of the Falls.

Appearance of the Falls at Varying Flows

Variations in flows over the Falls (PGE 2001a) affect its apparent height and the size, extent, and character of the water displayed on the crest, face and in its plunge pool. The apparent height of the Falls depends upon the height of the water in the plunge pool, which is affected by tidal action, variations in flows in the Clackamas River (which joins the Willamette downstream of the Falls), and variations in flows in the Willamette. The available hydraulic head fluctuates between 15 and 40 ft over the course of the year. At a flow of 100,000 cfs, the Falls' apparent height is reduced to about 15 ft, and at flood flows, the Falls virtually disappear and are detectable only as an area of turbulence in the river. The appearance of the Falls at varying flows is summarized in Table 15.

Table 15. Appearance of Willamette Falls at varying flows over the Falls.

Flow Level over Falls (cfs)	Appearance
2,500	On east face of Falls, a series of separate waterfalls with rock buttresses in- between. In some spots, thin ribbons of water flow across the buttresses. Flow in channel at apex of the Falls. No flow over big rock outcrop at the south face of the Falls and minimal flow over the fish passage structures.
3,500	On east face of Falls, separate waterfalls appear with rock buttresses between. Concrete fish passage structures evident on west face below crest. Water seen over east side of crest only. Area below crest contains more rock than water. Pools and the fish passage structures seen on west side.
17,000-18,000	East face of Falls broken up into a series of smaller focal elements. Boulders seen at base. Whitewater now seen in sections of crest. Some noise and mist. Area below crest contains exposed rock. Limited flows over south and west faces of Falls and fish passage's vertical wall, flat ledge, and sloping sill seen in on west face of Falls.
22,700	Much less energy than in the flows in the 30,000 – 40,000 cfs range. Rockform beneath Falls very evident at this flow. Large central rock feature is dry. Crest of Falls still fully covered and without whitewater. Ample noise. South and west faces much drier than at higher flows, with exposed rock and fish passage structures.
30,000-40,000	All features covered, except large rounded rock feature in center and fish passage structure at the apex of the Falls. Whitewater in all areas of Falls and below. Heavy mist throughout.
44,000	Most features on east face of Falls covered with heavy flows, only small portions of the buttresses are visible. On west face of Falls,

	water flows over most of fish passage structures, but its forms are detectable under the flows. On the south face, heavy flows around the large rock at the Falls' apex. The large rock is exposed, as is the fish passage structure at its base.

b. Environmental Impacts and Recommendations:

Aesthetic issues addressed in this section include (1) the effects of modification of the T.W. Sullivan Forebay; and (2) effects of modifications to the dam for a controlled flow structure.

Issue Statement

Environmental measures proposed to enhance downstream fish passage at T.W. Sullivan, BHPC, and Willamette Falls have the potential to adversely affect aesthetic resources in and around the Willamette Falls Project area. Recreation options also have the potential to temporarily affect aesthetics. The anticipated effects associated with the proposed options are described below.

Effects of T.W. Sullivan Forebay and Tailrace Measures (Tiers 1, 2, and 3)

Construction of T.W. Sullivan forebay and tailrace measures would have some impacts to aesthetic resources in the Project area. Cofferdams, construction equipment, materials, and activities within the T.W. Sullivan tailrace area would be visible in the middleground from the McLoughlin Promenade in Oregon City. These temporary features would not be focal elements in the view and would be consistent with the industrial appearance of the Project vicinity. Their visual effect would be minor.

Activities in the forebay area would be visible primarily to boaters in the USACE Locks. A boom or jib crane would be on site for up to one month during removal and installation of the trashracks. As this equipment would be consistent with the adjacent industrial activities, only minor effects on scenery would occur. Construction would likely be undertaken during the summer low flow period, which coincides with peak viewer presence. Construction effects would be temporary.

A new siphon spillway bypass adjacent to Unit 13, modifications to the discharge hydraulics of Units 12 and 13, or modification of the existing bypass system outfall to the tailrace would increase the amount of concrete and metal visible in the T.W. Sullivan tailrace, visible from the McLoughlin Promenade in Oregon City. When the new bypass spillway is in operation, an additional plume of whitewater would be visible. These effects would be minor, as the T.W. Sullivan tailrace is visible in the middleground from the Promenade and is not a focal element in views.

Effects of Blue Heron Paper Company Shutdown Management Measure

During those times that the BHPC powerhouse is shut-down to protect downstream migrants, all of the flow that would be used at the powerhouse, will be spilled over the Falls, increasing the flow over the Falls and enhancing its aesthetic character.

Effects of Modifications to Dam

Installation and operation of a controlled flow structure at the apex of the Falls would be visually apparent in the foreground and/or middleground from areas that view the Falls. It is expected that construction work would be accomplished with barge-mounted equipment suitable for cutting through concrete and steel. All removed material would be transported off site for disposal. Removal of flashboards or construction of the structure in the dam would be short-term and would take place near the apex of the Falls. These activities would be highly visible in the middleground from locations in West Linn and Oregon City.

At high to moderate flows, this measure would not detract significantly from the aesthetic value of the Falls themselves, and may add visual interest. A large proportion of the Falls may be dewatered in low flow periods because of flashboard installation and focussing the flow over the Falls at the apex location.

During lower flows, variations in the appearance of water spilling over the dam and through the controlled flow structure would be highly noticeable, especially at low flows when the water passing through the structure decreases or eliminates flow over the remainder of the Falls.

c. Conclusion:

Construction impacts on Project area aesthetics would be minor and temporary. As described above, several of the proposed enhancement measures for downstream fish passage would have visual impacts, particularly during periods of low flow. T.W. Sullivan measures would add new structural elements to the tailrace, as seen from the McLoughlin Promenade.

Facilities and operations associated with the controlled flow structure at the Falls apex could alter the highly modified, yet now familiar appearance of flows over the concrete dam and flashboards during low flow conditions.

No specific aesthetics measures are proposed.

d. Cumulative Effects:

Several of the proposed downstream fish passage measures would add to the existing visual disturbance of the industrial complex in the vicinity of the T.W. Sullivan, the Falls, and BHPC facilities. This additional disturbance would be apparent from some but not all key-viewing locations. As the structures age, colors fade and the materials are weathered over time, the enhancements would better blend into the landscape and the aesthetic impacts would be reduced.

e. Unavoidable Adverse Effects:

A new siphon spillway bypass adjacent to T.W. Sullivan Unit 13, modifications to the discharge hydraulics of Units 12 and 13, or modification of the existing bypass system outfall structure would have unavoidable adverse effects upon the scenery resources apparent from the McLoughlin Promenade in Oregon City. As described above, these effects would be minor.

7. Cultural Resources

a. Affected Environment:

Willamette Falls has been an important center of regional cultural activity for thousands of years. The Falls created an obstacle to the upstream migration of fish, passable only by spring chinook salmon, winter steelhead, and Pacific lamprey. For Native Americans, this provided an ideal setting for a dip-netting and spearing fish resource, as the spring and summer migratory salmon concentrated in the quiet water between the Falls and the Clackamas River mouth, 1.8 miles downstream. Lamprey were taken from the rocks of the Falls. The fish resource attracted many groups to the area to fish and trade for dried fish and other goods. The Falls was a major center for trade among Native Americans in the Lower Columbia-Willamette Valley region. The industrial potential of the Falls was quickly recognized by EuroAmericans immigrating to the Pacific Northwest and the area is one of the earliest and longest inhabited EuroAmerican settlements in this region. Pioneering advances in electrical transmission were made at the Falls and hydroelectric power has been generated there since the late nineteenth century.

Area of Potential Effect

The geographic areas examined for the three aspects of historic properties (traditional cultural, archaeological and historic resources) differ in their extent. These areas, defined as Areas of Potential Effects (APEs), are depicted on Figure 3. The APE for the ethnographic (Traditional Cultural Properties [TCPs]) investigations is the broadest, reflecting the potential for the Project to affect traditional uses and associations with places beyond t+he FERC Project boundary. The APE for archaeological resources

includes all lands within the FERC Project boundary. Due to the interconnected nature of the hydropower projects with mill developments on both sides of the river, the APE for historic structures extends beyond the FERC boundary, as depicted on Figure 3.

The general prehistoric context for the Portland region of the Lower Columbia River has been explored, interpreted, and presented in several studies (e.g., Ames 1994; Minor *et al.* 1994; Pettigrew 1990). A three stage pre-contact cultural sequence, along with a short historic period, has been adapted from previous regional studies and models (Oetting 2001). These models highlight the development of sedentary villages, intensive economic strategies, and complex social organizations culminating in the Formative Stage.

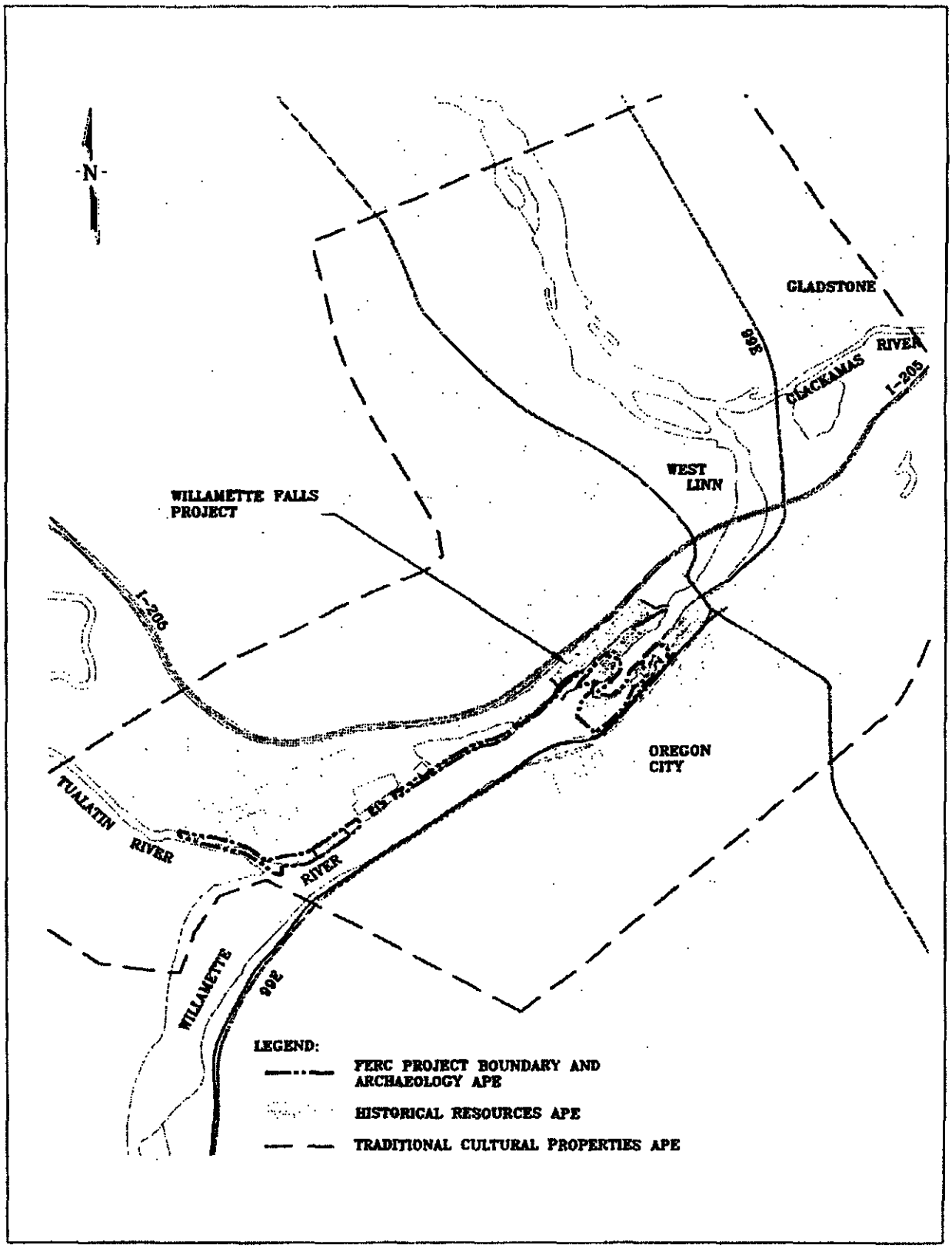

Figure 3. Areas of potential effect for cultural resource investigations.

Previously Identified Archaeological Resources

Numerous archaeological sites and artifacts have been found in the West Linn-Oregon City area, but most are outside of the APE (Figure 3). The State Historic Preservation Office (SHPO) records indicated that two archaeological sites were probably within the APE and several were recorded within 5 miles. A rock art petroglyph site (35CL236) has been recorded in the APE and an archaeological site (35CL14) was recorded upstream from the Falls. This site corresponds to the location of an abandoned Indian village described by Alexander Henry in 1814.

Results of Surface and Subsurface Inventories

Surface and subsurface investigations were conducted in the Project archaeological APE between March and September 2000 (Oetting 2001). A surface and subsurface inventory focused on the portion of the APE on the west side of the Willamette River, upstream from the powerhouse and locks area, and the section along the north shore of the Tualatin River. The remainder of the APE was excluded from survey due to disturbance by modern industrial development or for safety reasons.

No archaeological artifacts, features, or sites were identified during the pedestrian surface survey conducted in 2000, but survey information guided the subsequent subsurface tests (Oetting 2001). Site 35CL14 was located and evaluated during the subsurface tests. Three locations with isolated prehistoric or historic artifacts were evaluated with the subsurface test probes. One hundred-sixteen 30 cm-diameter round shovel probes were excavated, 89 as site discovery probes and 27 as site evaluation probes at site 35CL14. No surface artifacts were found in the 35CL14 site area, but prehistoric cultural materials were found in 13 of the 27 excavated probes. Portions of this site have been disturbed by modern industrial developments unrelated to the Willamette Falls Project and Project operations do not affect this site. This site is considered a significant archaeological resource and is recommended as eligible for the National Register of Historic Places (NRHP).

Site 35CL236 consists of three panels of petroglyphs. The primary panel is in good condition and it is likely that the other panels are also well preserved. Current Project operations do not affect the physical integrity of this site. It is recommended that site 35CL236 be considered a significant archaeological resource that is eligible for inclusion in the NRHP.

Three isolated finds were also identified during probe excavations. Two locations yielded a few chert flakes, but no additional cultural materials were found. The third location consisted of three historic items. No intact features and no other clearly historic items were identified around this location. The objects recovered at these locations do not meet the criteria for National Register significance evaluation (National Historic

Preservation Act of 1996, 36 CFR Part 800) and so are recommended not eligible for the NRHP.

Traditional Cultural Property

As described above, Willamette Falls has been a center of Native American cultural activity for thousands of years. Archival materials document fishing use well into the twentieth century. Consultation to date with area Tribes indicates considerable knowledge of traditional use of the Project area. It also reveals ongoing interest in the use of Willamette Falls area.

Based on ethnographic studies conducted to date, it appears that the Falls will meet the National Register criteria for designation as a Traditional Cultural Property (36 CFR 60.4) associated with sustained fishing use by at least two Native American Tribes.

Fur Trade Period (1811–1845)

Few records of this era describe the Native people of the Project area, an exception being the observations of Alexander Henry, a fur trader who visited the Falls in January 1814 (Gough 1992). He described a native village near the Falls and their foodstuffs. Later that year, another trader identified the Falls as a fishing and gathering place used by Indians throughout the surrounding country (Gough 1992). People living near the Falls at this time appear to have been Chinook-speaking, and they controlled access to the Falls and the salmon taken there (AINW 2001). The other fish resource described at the Falls is lamprey (Townsend 1999).

Dr. John McLoughlin of the Hudson's Bay Company (HBC) at Fort Vancouver, recognized the power generating potential of Willamette Falls and claimed the east shore in 1829. He planned a sawmill at the Falls in the early 1830s, an idea that was implemented in 1842 by the HBC. Two American ships arrived in the area in the fall of 1829 to compete for furs and salmon with the HBC. One ship, the Owyhee, is thought to be the source of the outbreak of malaria that almost destroyed the people of the lower Columbia region in the early 1830s. The Indian population of the Willamette Valley and lower Columbia Valley was reduced by 75 to 90 % or more. The decimation of Native groups by disease severely disrupted traditional life in the Willamette Falls area. Other groups who may have been only seasonal visitors to the Falls began moving into the area. This dynamic was complicated by the arrival of the EuroAmericans, who encountered little resistance to their settlement.

American Settlement and the Willamette Valley Treaty

After 30 years of joint British–American occupancy, the Oregon Country became American territory in 1846. Waves of immigration from the United States in 1843, 1844 and 1845 prompted this political shift. Oregon City became the seat of the Provisional

Government in 1844 and the first incorporated city west of the Missouri River. For this 20-year period, the Willamette Valley was the destination of most immigrants, and Oregon City, the terminus of the Oregon Trail, became the region's first urban center. Flour and sawmills powered by the Falls provided an industrial base for the town. This rapidly growing EuroAmerican population cleared land for farming and towns, further displacing Native groups. The legality of land claims was questioned, since title had not been obtained from the Indians. Accordingly, the territorial governor and the Oregon Superintendent of Indian Affairs began a series of negotiations to arrange for cessation of Indian title. Because few were willing to relocate east of the Cascades, several small reservations were established in the Willamette Valley (*Oregon Spectator* 1851 a and b). Ultimately, a treaty was ratified in 1855 by four groups with traditional ties to Willamette Falls: the Molalas, the Clackamas, the Wal-lal-lah Band of Tumwaters, and the Clowewalla or Willamette Tumwaters. Most moved to the Grand Ronde Agency or the Siletz Reservation (Beckham 1977).

By the late 1800s, foot access to the Falls was being steadily reduced by development. By 1851, there were several mills and boat landings on the east side of the Falls (Bushnell 1938; GLO 1852; Ives 1851). With the construction of fish passage facilities in 1885 and passage of state laws in 1893 and 1901 prohibiting fishing within 600 ft of any ladder, Indian fishing opportunities were largely eliminated by about 1900.

Members of four Tribes are known to currently use the Willamette Falls area: Confederated Tribes of the Grande Ronde Community, Confederated Tribes of the Siletz Indian Reservation, Confederated Tribes of the Warm Springs Reservation, and the Yakama Indian Nation. Members of these and perhaps other Tribes also may use the Falls to fish for salmon, steelhead, and lamprey. A variety of methods are used to harvest salmon and steelhead, while lamprey generally are collected by hand from exposed rocks. These activities are regulated by ODFW, which defines the season and harvest locations by species. Information to date has not indicated any Tribal preference for specific locations at Willamette Falls for taking salmon, steelhead, or lamprey.

Historic Resources at Willamette Falls

The water energy of the Falls was both harnessed and bypassed in the latter part of the nineteenth century. In 1864, the first woolen mill in Oregon opened on the east edge of the Falls. In 1866, the first paper mill in the Pacific Northwest was built on this bank as well. The Falls remained an impediment to river travel until 1873, when the Willamette Falls Canal and Locks bypassed the Falls and eliminated portage problems. Development of the complex of industrial buildings that now line both sides of the Falls began in the1880s. Paper mills built on the basalt bench bordering the canal and locks used water from the locks to power their machinery.

Electrical interests in Portland realized that the generating power of Willamette Falls was a key to growing local electricity demands. A generating plant, Station "A",

was constructed atop the east side of the Falls horseshoe. In June 1889, direct current (DC) electricity was transmitted over 14 miles of lines to downtown Portland, the first successful long distance transmission of electricity in the United States (Greisser 1982; Wollner 1990). Station A was modified the following year and AC current was also transmitted long distance to Portland, another first (PGE and BHPC 1998a).

Construction of a new power plant, Station "B," began in 1893 to serve the steadily increasing Portland market. This new station on the west side of the Falls began electric generation in 1895 (Greisser 1982). Station A was abandoned around 1897 and its electrical equipment was moved to other facilities. By 1903, Station B was producing 5,730 kW of electricity. It was reconstructed and modernized in 1952, returning to operation in 1953 with a generating capacity that had been increased to 15,000 kW (Greisser 1982). In honor of Thomas Sullivan, Station B was renamed the T. W. Sullivan Hydroelectric Plant.

Thus, by the beginning of the twentieth century, much of the dense industrial development that today characterizes the Willamette Falls Project area was already in place. Modifications and some additions have been made to the neighboring mills, and they have changed ownership over the years.

The Willamette Falls Locks and Canal is listed on the NRHP. In addition, the Oregon SHPO determined that Grinder Rooms 2 and 3 of the WLPC are eligible for listing on the NRHP.

The Applicants conducted an additional assessment of the paper mill and hydropower complexes to determine their historic significance. The complex, referred to as the Willamette Falls Industrial Area (Kramer 2001), demonstrates significant association with the development of hydroelectric power and establishment of the papermaking industry in the State of Oregon. It is one of, if not the oldest, continuously operated industrial site in the state.

The integrity and significance of 46 structures in this Industrial Area were examined by the Applicants (Kramer 2001). National Register standards and evaluation terminology were used in this study, evaluating components as Historic Contributing, Historic, Non-Contributing and Non-Historic, or Non-Contributing. A Request for Determination of Eligibility (DOE) for the NRHP has been drafted for the Willamette Falls Industrial Area, citing 33 historic contributing elements (Kramer 2001). The Willamette Falls Industrial Area is significant under Criterion A for its role in the history of industrialization of Oregon. Certain structures within the complex, most notably Station B (T.W. Sullivan), are additionally significant under Criterion C for their association with the development of hydroelectric power technology in the nineteenth century. A Request for Determination of Eligibility (DOE) for the NRHP was submitted to the Oregon SHPO for evaluation of the Willamette Falls Industrial Area, citing 33 historic contributing elements (Kramer 2001). The SHPO concurred with the findings of

the evaluation, stating that "...the Willamette Falls Industrial Area is clearly eligible for listing in the National Register as a historic district for its role in the history of industry in the State of Oregon... In addition, to being eligible, the Willamette Falls Industrial Area includes at least two properties that appear to be individually eligible; Station B, known as the T.W. Sullivan Hydroelectric Project, and the foundations of Station A." (letter from Christine Curran, SHPO, to Julie Keil, PGE, June 4, 2002).

b. Environmental Impacts and Recommendations:

The National Historic Preservation Act (NHPA) of 1966 requires federal agencies manage cultural resources under their jurisdiction and authorizes the Secretary of the Interior to maintain a National Register of Historic Places. The NHPA also designates SHPOs to facilitate implementation of federal cultural resource policies at the state level, and for the FERC to consult with Native American Tribes who attach religious or cultural importance to a site or area. Section 106 requires federal agencies take into account the effect of any proposed undertaking on properties listed or eligible for listing in the National Register. If the agency determines that an undertaking could adversely affect such a property, the Advisory Council on Historic Preservation (Advisory Council) will be given an opportunity to comment on the undertaking.

Issue Statement—Tribal Access

The Willamette Falls area is significant to Native Americans as a fish resource. Members of at least four Tribes are known to collect salmon, steelhead and lamprey at the Falls. A variety of fishing methods are used to harvest salmonids and lamprey are collected by hand from exposed rocks. Pedestrian access to the Falls has been limited by industrialization since about 1900. Additionally, river access for fishing has become more difficult for Tribal members as they must compete with large numbers of non-native anglers. While competition affects all anglers, the cultural importance of salmon, steelhead, and lamprey, is a major issue for the Tribes.

Effects of T.W. Sullivan Forebay and Tailrace Measures

These options should have a beneficial affect for Tribal anglers presuming that the enhanced downstream passage of salmon, steelhead and lamprey results in increased survival and subsequent returns of more adult fish to Willamette Falls.

Effects of Blue Heron Paper Company Shutdown Management Plan Measure

This measure should have a beneficial affect for Tribal anglers presuming that the enhanced downstream passage of salmon, steelhead and lamprey results in increased survival and subsequent returns of more adult fish to Willamette Falls.

Effects of Modifications to Dam

Potential effects from this measure varies. Flow over many sections of the Falls would be decreased at certain times of the year to improve downstream fish passage by focusing flow through a structure at the apex of the Falls. Selective removal of flashboard sections, plus the removal of felt cloth from other sections, would provide limited flow at other locations around the Falls and may reduce fish stranding in the scour pools below the Falls. The effect of these flows on upstream and downstream lamprey passage is not specifically known; however, one of the objectives of modifying the dam is to facilitate lamprey passage. The ability of Native Americans to harvest lamprey would be reduced at the apex of the Falls due to the increase of flow at this location; however, the lower flows at other locations may increase bare rock exposures and make it less dangerous to access harvest locations on foot. Additionally, measures that improve fish survival ultimately would help sustain traditional harvest opportunities at the Falls.

Effects of Recreation Measures

Recreation measures would have no effect on traditional cultural use of the Falls.

c. Cumulative Effects:

Historically, Native Americans were able to access the Falls on foot and by boat. Land access largely was eliminated in the early 1900s. While boat access remains available, Tribal members must compete with large numbers of non-Tribal anglers, sometimes in competition with "hoglines" that form across the river below the Falls. A hogline is a group of boats tied in a row across a stream to maximize the opportunity to intercept fish moving upstream, a practice that is unrelated to the Project. This practice can monopolize a reach of river, and limits access to many anglers at the Falls. This is considered a major issue for some Tribes given the cultural importance of salmon, steelhead, and lamprey, and the importance of Willamette Falls as a harvest location.

The Tribes also view the commercial harvest of lamprey as an access issue. In 2002, ODFW issued permits for only personal harvest of lamprey at Willamette Falls. With regionally declining numbers of lamprey, commercial harvest identified as a practice that may be in conflict with Tribal harvest opportunities. Consistent with regional heightened concern for lamprey, ODFW implemented harvest restrictions for the lamprey fish resource at Willamette Falls.

Issue Statement—Historic and Archeological Sites

Project operations, future construction and maintenance activities, proposed enhancement and mitigation measures, and changes in land use practices could contribute to the loss of sensitive historic and archaeological sites in the Project area.

Effects of T.W. Sullivan Forebay and Tailrace Measures (Tiers 1, 2, and 3)

None of the measures being evaluated in the T.W. Sullivan forebay would have an effect on known archaeological resources.

The historical character of the T.W. Sullivan facility would be maintained if the proposed trashracks were visually compatible with the existing racks. New rack height, material, and color should be similar to the existing racks. Adoption of these recommendations should result in a Finding of No Adverse Effect to the T.W. Sullivan plant under Section 106 of the NHPA.

Neither siphon spillway modifications nor the installation of an Eicher screen in Unit 12 would be expected to have an adverse effect on the plant's historic qualities. Modifying the discharge from Units 12 and 13, and possibly adding a trashrack cleaning system to the forebay trashracks, would require an evaluation under Section 106 of the NRHP; however, the new features are expected to be sufficiently compatible with the existing features to result in a Finding of No Adverse Effect.

If implemented, the effects of modifying the existing Unit 13 bypass system outfall chute, or adding a new long and branching bypass chute from T.W. Sullivan Units 12 and 13, would depend upon the eventual design and material chosen for the structures. To maximize consistency of this addition with the surrounding industrial facilities, the use of unpainted metal is recommended for the flume. This material would blend with the historic character of the adjacent mill facilities. SHPO review of this component would be required to determine consistency with Section 106 of the NHPA. If the selected chute material sufficiently blends with the surroundings, this option would be expected to have no adverse effect on the historic Willamette Falls Industrial Area.

Effects of Blue Heron Paper Company Shutdown Management Plan Measure

There are no known archeological sites at the Blue Heron Power Plant. Shutdown and decommissioning would have no effect.

Effects of Modifications to Dam

From the perspective of historical structures, the dam is considered to be an historic contributing feature to the Willamette Falls Industrial Area. As such, physical modifications to the 1943-era dam could be an adverse effect. Changes to the dam have continued over the past century and a half, so despite the impact, proposed modifications may be an acceptable fish passage option. Installation of sections of inflatable rubber dam would occur below the water line and are, to a degree, a more "temporary" material. Therefore, this may be considered a benign structural modification.

A controlled flow structure at the apex of the Falls would alter the existing pattern of flow over the Falls. This measure would break the uniform veil of water that is a

characteristic feature of the long dam running along the crest of the Falls. Because the dam is a contributing historic resource to the Willamette Falls Industrial Area, the proposed measure would have to be reviewed by the SHPO to determine consistency with Section 106 of the NHPA. Depending on the final design and operating scenario, this finding could be an adverse or a no adverse effect determination. The current dam structure dates to 1943 and represents the latest in a series of dams that have extended back to the 1830s; therefore, modifications may be viewed as a continuing evolution of this industrial element.

Effects of Recreation Measures

Recreation measures would include working with the city of West Linn to grant an easement to facilitate their public trail program, and providing support to local heritage organizations with the development of Project area interpretive and educational materials. The potential effect on historic properties varies by measure, as described below.

Interpretive and Educational Enhancements: This measure would involve developing a strategy and implementing interpretation and education measures related to hydropower, local industrial development, fish passage and Native American use of the Falls. The Applicants may provide support to the West Linn Cultural Heritage Committee or Museum of the Oregon Territory for development of interpretive material. No adverse effects on cultural resources would result from these measures.

c. Cumulative Effects:

None have been identified.

d. Recommendations:

To continue consultation to resolve potential adverse effects to historic properties, Applicant propose to:

- Develop and implement a Historic Properties Management Plan (HPMP), incorporating the above-listed measures, as well as procedures for the management of historic properties over the term of the new license. Continue to work with the Tribes to define an area at Willamette Falls that may constitute a Traditional Cultural Property, and to extent that it is within the control of the licensees, consider its actions on that site.
- Incorporate into design specifications for exterior Project modifications the use of materials and surface finishes that are visually compatible with existing historic structures.
- Develop an interpretive and educational strategy and materials about industrial development and Native American significance of the Falls.

e. Unavoidable Adverse Effects:

Approval of an HPMP by the SHPO and the Advisory Council, implemented through a Programmatic Agreement developed by Commission staff, would ensure the licensees consider any adverse effects to historic properties arising from Project modifications or operations over the term of a new license, are avoided or resolved.

8. Recreation and Other Land and Water Resources

a. Affected Environment:

Recreation

Project Area Recreation Resources

Notable nearby destinations include the Pacific Ocean, the Cascade Mountains and the Columbia River. Public lands that offer developed recreation facilities, primitive hiking and camping, and scenic driving opportunities include the Mount Hood National Forest, the Mount St. Helens National Volcanic Monument, the Columbia River Gorge National Scenic Area, and the Mount Adams wilderness area. More urban recreation opportunities are provided in the adjacent communities of Oregon City, West Linn, and Portland. Near Willamette Falls, popular activities include fishing downstream of the Falls; boating both upstream and downstream; and picnicking at developed parks.

Project Recreation Facilities

Due to the constraints of this highly industrialized site, the Applicants have not developed recreation facilities at Willamette Falls. PGE has leased land to the City of West Linn for two developments within and adjacent to the Project boundary, Bernert Landing and Willamette Park, described in the next section. Although unrelated to the Project, PGE has developed nine public recreation areas in Oregon, seven of which are located within 60 miles of Portland and the Project.

Other Public Recreation Facilities

Immediately surrounding Willamette Falls are active industrial complexes that constrain direct recreational access and use. However, several recreational developments are found nearby (Figure 4). The Willamette Falls Locks and Canal, built in the early 1870s, is operated by the USACE, along with an historic visitor center and picnic area. Today, 90% of the watercraft passing through the locks are recreational rather than commercial. The canal forms the western Project boundary.

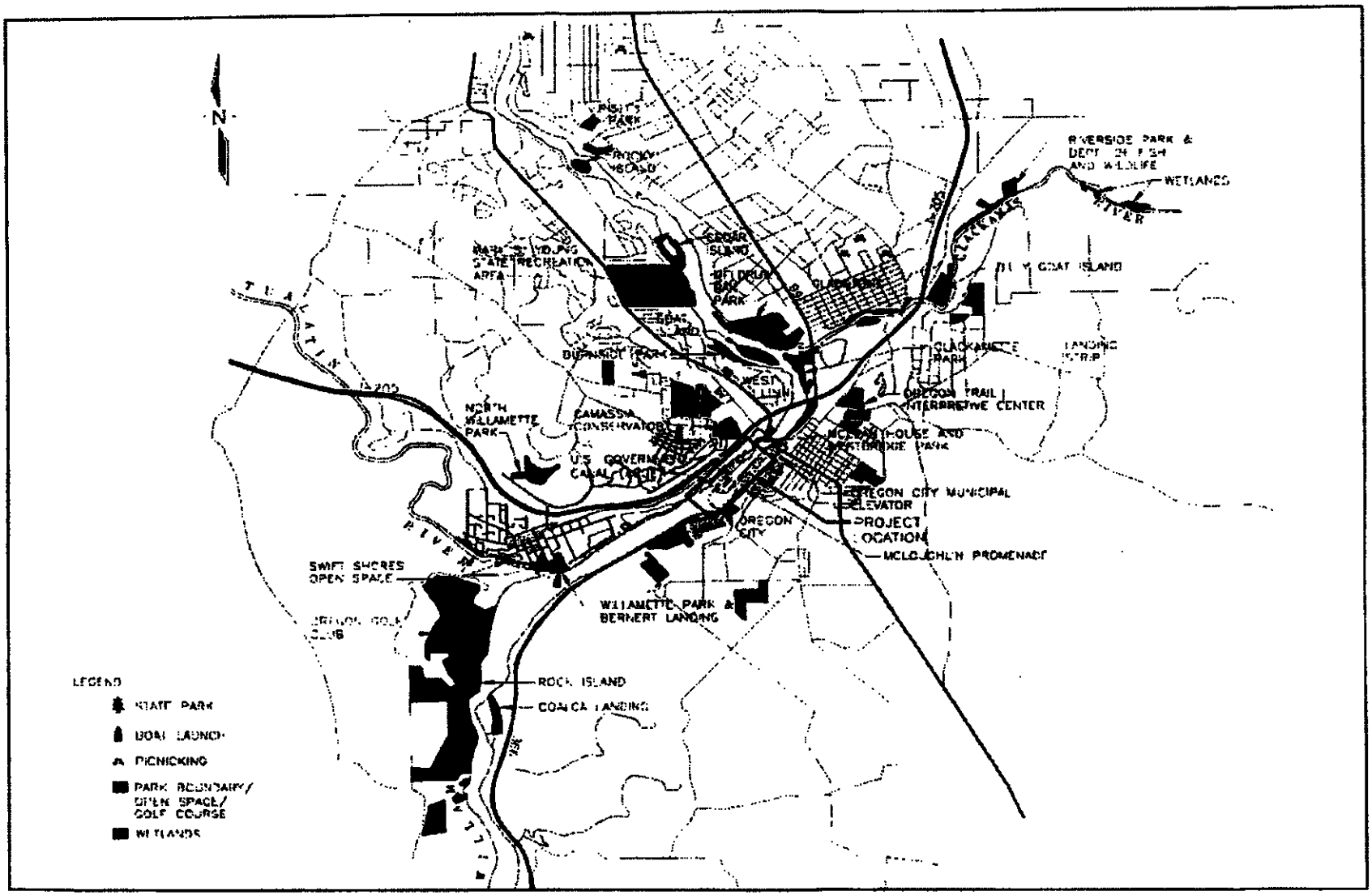

Figure 4. Project area recreation facilities.

Bernert Landing, located within the Willamette Falls Project boundary, provides easy river access about two miles upstream of the Falls. This well-maintained 2.16-ac site has parking, restrooms, a dock, and 650 ft of river access. It is managed by the City of West Linn on lands that have been leased from PGE since 1980. Willamette Park is adjacent to Bernert Landing and is also managed by the City of West Linn. It occupies 19.1 acres at the mouth of the Tualatin River and has 1,240 ft of waterfront. The site has parking, three baseball/softball fields, three soccer fields, restrooms, and various other amenities. Some of the facilities are on land leased from PGE.

The undeveloped Tualatin River and Swift Shores open space areas, located along the Tualatin River adjacent to the upstream extent of the Project boundary, are owned by the City of West Linn. These areas provide unstructured shoreline access to the Tualatin River.

Downstream of Bernert Landing and Willamette Park, much of the Willamette River's western shoreline within the Project area is undeveloped. This area is interspersed with industrial development, and public access has never been encouraged.

The area below Willamette Falls is frequently used by Native Americans and supports robust fish resources (see Fish Resources in Socioeconomics section). The sidewalk in downtown Oregon City extends along the riverbank and is a popular destination for anglers. In addition to salmon fishing, Native Americans harvest Pacific lamprey annually between June and August, primarily by wading into the water at the Falls during low flows.

The 21.8-ac Clackamette Park in Oregon City is a heavily used regional facility located one mile downstream from Willamette Falls. Within one-half miles of the Falls is the End of the Oregon Trail Interpretive Center. The Oregon City Trolley begins and ends at this interpretive center, passing along the McLoughlin Promenade where views of Willamette Falls and the hydroelectric Project are available. Additional Oregon City visitor attractions include the numerous historic homes and viewpoints overlooking the Project site. Oregon City also has plans to construct a significant transient tie-up facility adjacent to 8th Street. The facility will include a land connection, and provide opportunity for viewing Willamette Falls and other adjacent sites.

Use Levels and User Characteristics

Recreational use information relevant to the Willamette Falls Project is contained in the State-wide Comprehensive Outdoor Recreation Plan (SCORP), Washington SCORP, Oregon State Marine Board (OSMB) studies, USACE locks visitation figures, PGE's FERC Form 80, and the West Linn Parks, Recreation, and Open Space Plan. This information is summarized below and described in detail in the Willamette Falls Recreational Resource Report (PGE and BHPC 2001b).

State-wide Comprehensive Outdoor Recreation Plan (SCORP)

Much of the available recreation demand information for the Willamette Falls Project comes from surveys conducted by the OPRD as part of the SCORP Region 5 planning process (OPRD 1988). The 1988 SCORP demand study found the following participation rates for activities undertaken in the Project vicinity: picnicking (67% participate), hiking/walking (66%), nature study (47%), boating (43%), and biking (28%). Based on this information, OPRD projected growth rates for these activities (Table 16). Community-based recreation is defined as those activities occurring within a 30-minute drive from a recreationist's home. This concept was explored in the OPRD 1994 SCORP. Neighborhood park walking, jogging, and running was most popular, with 59.1 % of respondents stating that they participated in this activity. The next most popular activities were picnicking (49.6 %) and unpaved trail walking and hiking (43.5%). In almost all activities, proximity of a given facility was seen to have a direct relationship to participation.

Table 16. Projected growth rates for recreation activities in Oregon.

Activity	Yearly Increase (%)
Low Growth Activities	
River powerboating	1.2
Moderate Growth Activities	
Bank/dock fishing (freshwater)	2.5
River non-motor boating	3.7
Picnicking	3.8
Sightseeing/exploring	4.9
Water skiing	5.5
Boat fishing (freshwater)	5.5
High Growth Activities	
Visiting interpretive centers	6.6
Nature study/wildlife observation	8.6
Outdoor photography	9.3
Jogging/running	9.3
Day hiking on trails	11.9
Bicycling on road (day trip)	12.0

Source: The Oregon Outdoor Recreation Plan: 1988–1993. (Oregon Parks and Recreation Department 1988)

Oregon State Marine Board Studies

The Oregon State Marine Board (OSMB) identified the Willamette as the most popular waterbody in the state after the Columbia River in both 1992 and 1995 (OSMB 1998). Boating facilities are provided at various public and private developed sites in the Project area, including boat launches, restrooms, and docks. Fishing, waterskiing, personal watercraft use, and boating for pleasure occur above and below the Falls. In the OSMB study, boaters reported that 31% of their time on the Willamette is spent waterskiing, 38% for fishing, and 24% for cruising. Non-motorized boating use is believed to be low. Boat fishing is especially heavy below Willamette Falls during the salmon and steelhead migrations (PGE 1999). Some of the most heavily used boat ramps in Clackamas County are in the immediate Project area, Sportcraft Landing, Bernert Landing, and Clackamette Park (OSMB 1998).

The OSMB has identified a number of boating-related issues on the Willamette River in Multnomah and Clackamas counties (OSMB 1998). For instance, in 1992, 30% of boaters said that they avoid the river because there are "too many boats," and 52% because of "possible conflict with other boaters". These figures are much higher than those found for any other waterbody in the state and suggest a significant capacity/demand problem for the Willamette River (OSMB 1998). Additionally, it ranked among the top areas in terms of waterway management problems.

Willamette Falls FERC Form 80

PGE's FERC Form 80 estimated 1997 use at 30,000 recreation visitor days (RVD, defined as use by one person for a day or a portion thereof). These estimates were not based on actual visitor counts at either the USACE locks or at Willamette Park, but provide a general indication of visitation to the Project area based on other recreation provider use estimates. On peak weekend days, use was estimated at 1,000 RVDs. All recreational use occurred during daylight hours, as no overnight facilities exist within the Project area. The vast majority of recreation activity takes place at Willamette Park, Bernert Landing, and in the Willamette River downstream of the Falls.

Willamette Falls Locks Visitation

Table 17 displays walk-in visitor and vessel counts for the Corps of Engineers-operated Willamette Falls Locks between October 1997 and September 1998. Nearly 29,000 walk-in visits were recorded for this 12-month period. Commercial traffic was generated largely by the WLPC, whose shipments now are made entirely by truck (I.R. Mendez, USACE, personal communication, January 2, 2001).

Table 17. Willamette Falls Locks monthly visitation figures.

Month	Walk-InVisitors	Recreational Vessels
October 1997	1,048	52
November 1997	1,047	46
December 1997	524	32
January 1998	693	66
February 1998	693	90
March 1998	2,077	183
April 1998	1,739	453
May 1998	3,479	609
June 1998	3,480	888
July 1998	2,764	756
August 1998	5,528	540
September 1998	5,528	720
TOTALS	28,600	4,435

Source: G. Cobb, U.S. Army Corps of Engineers, 1999.

West Linn and Oregon City Recreation Use Characteristics

A measure of current recreation participation trends shows West Linn to be a very active community. Of the 40 activities measured by household surveys conducted in 1996 (Draggoo 1998), 31 were higher than the Northwest average. The most dramatic differences were in walking for pleasure, gardening, visiting/using playgrounds, and indoor swimming. Willamette Park is by far the most heavily used site in West Linn, with an estimated 20,000 annual visits. According to the household survey (Draggoo 1998), more than 30 % of city residents use this park one to five times each year.

Area Recreation Needs

Regional Needs

The OPRD determined "high" (greater than 43%) resident participation rates for the following recreation activities relevant to the Project: picnicking, hiking/walking, and boating. River power boating was believed to be experiencing "low" growth (1.7 % annually). Fishing (bank/dock/boat), river non-motorized boating, picnicking, sightseeing, and water skiing were believed to be growing "moderately" (2.5 to 5.5 % annually). "High" growth (greater than 5.5 % annually) activities included visiting

interpretive centers, nature study/wildlife observation, outdoor photography, jogging/running, day hiking, and bicycling.

OSMB recreational studies revealed that the Clackamas County reach of the Willamette River, which includes the Project vicinity, is very heavily used.

City of West Linn

Public surveys and workshops, conducted in 1996 and 1997 (Draggoo 1998), revealed that a City-wide path and trail system was the most needed type of open space, followed by riverfront parks and natural open space. Participants in community workshops recommended acquisition of parcels that link sites already owned by the City along the Tualatin and Willamette. A cooperative or joint venture with the Applicants, the state, and/or private individuals was suggested to gain access to the river's edge.

Other Land and Water Resources

Project Setting

The presence of Willamette Falls influenced the historical development of the Willamette Basin, with waterpower-operated flour, paper, woolen, brick, and lumber mills attracting residents since 1832. Oregon City, located on the east bank of the Falls, became the first incorporated city west of the Missouri River in 1844, and the original capitol of the Oregon Territory. The community of West Linn, developed on the west side of the Falls, was incorporated in 1913.

The Project occupies 88.9 acres within the city limits of West Linn and Oregon City. The majority of these lands are used for industrial purposes associated with hydropower generation and paper production. A narrow band of Project land along the western Willamette River shoreline includes mixed uses such as recreation, residences, and transportation.

Existing Land Uses and Ownership

Current uses of lands within and adjacent to the Willamette Falls FERC Project boundary can be grouped into four categories: Project operations, commercial and industrial, recreation, and natural resource. The 88.9-ac Project site encompasses approximately 33 acres within the Oregon City limits and 56 within the City of West Linn.

Project Operations

BHPC Development—The 1.5 MW BHPC generating facility is located in a small, wood-framed building near the eastern end of the rocky horseshoe of the Falls. It houses two turbine generators, the first installed in 1916 followed by the second in 1924.

Turbine intakes are located in the small bay in the upstream portion of the basin originally constructed for PGE's historic Station A plant, over which the BHPC powerhouse was constructed. This basin is formed on one side by the riverbank and railroad grade and on the other side by the dam and the rocky outcropping of the Falls. The BHPC powerhouse operates year round except during a six- to eight-week period between February and June. Because of its historical link to Station A, the BHPC Powerhouse has been determined to be eligible for the National Register of Historic Places (PGE 1998b).

T.W. Sullivan Development—The 16 MW T.W. Sullivan facility, built in 1893 – 1895, is documented as the oldest and longest continuously operating hydroelectric facility in Oregon (PGE and BHPC 1998a). Primary Project facilities include the 2,950-foot-long dam around the crest of the Falls, a forebay with headgates beneath the abandoned WLPC sawmill, and a powerhouse containing 13 generating units. The low gravity dam follows the crest of the horseshoe Falls and is freely overtopped by the Willamette River. PGE installs two-foot high flashboards from July through September, raising the impoundment for power generation purposes. This measure also facilitates summer operation of Clackamas County's Canby Ferry, which provides service between the upstream communities of Canby and Wilsonville.

WLPC structures surround three sides of the T.W. Sullivan plant and the Willamette Falls Locks forms the fourth side and western boundary of the site. Because of its significance in the pioneering period of energy generation in the Portland area, the T.W. Sullivan facilities have been determined to be eligible for the National Register of Historic Places (NRHP) (PGE 1998b).

Commercial and Industrial Uses

Willamette Falls is a highly industrialized site within a reach of the river that otherwise is more oriented to recreation, residential, and light commercial uses. These industrial links are historically rooted to the region and therefore are largely consistent with current local land management designations.

BHPC—The BHPC facility has been an active paper mill since 1909. Its major product since 1916 has been newsprint. Significant modifications to the facility in the 1970's added a recycled newsprint process, increasing the original capacity of 25 tons to 450 tons of newsprint and magazine stock per day. The raw material for paper production, wood chips and recyclable paper, arrive via rail and truck. A Southern Pacific Railroad corridor forms the eastern boundary of the BHPC facility and State Highway 99 East is less than a quarter miles away. Approximately 20 to 30 rail cars of wood chips and 80 to 100 truckloads of recyclable paper are delivered per month. Approximately 10 rail cars and 100 to 200 truckloads of finished rolls of newsprint and magazine stock are shipped per month. The BHPC facilities occupy 4,000 ft of river frontage in downtown Oregon City, but due to its industrial nature, public access is not

permitted. The company also operates a 14.7-ac settling lagoon about one mile upstream on the west bank of the river. Mill process water is pumped across the river through a pipeline to the lagoon. Only a small part of the BHPC production facilities are located within the FERC Project boundary. The land underlying the mill facilities is owned by BHPC.

WLPC—The WLPC mill is situated on an island extending approximately 0.75 miles along the west bank of the Willamette River. This island is shared by the T.W. Sullivan facility. The mill began operation in 1889 and has continued under a series of operators. It currently operates 24 hours a day and produces approximately 210,000 tons of coated free-sheet paper per year. Approximately 315 tons of hardwood and softwood pulp and another 205 tons of additives are delivered by truck daily. Approximately 6.5 million gallons of incoming process water are filtered daily. Outgoing wastewater is clarified to remove solids, which are then dried for use as a limestone substitute at local sod farms. Water is then pumped to a 26-ac aeration lagoon located approximately one mile upstream.

The island on which the mill is located is separated from the mainland by the Willamette Falls Locks and canal. Vehicle and pedestrian traffic cross onto the island over a single, 10-foot-wide counter-balanced drawbridge that is owned and maintained by the paper company. Incoming freight, maintenance, chemical, and finishing supplies must cross the drawbridge by forklift. In addition, finished products are transported off the island across this bridge to an adjacent warehouse for round-the-clock truck shipment. For reasons of safety, security and emergency access, admittance onto the island is restricted. Public tours are prohibited as a matter of policy because of the continuous, heavy flow of mobile equipment.

Willamette Falls Locks and Canal—Since 1873, navigation around the Falls has been provided by a series of locks. It is estimated that from 1940 to 1970, these locks passed an average of 500 tons of commercial products per year, much of it rafted logs. From 1970 through 1996, commercial river transportation was related primarily to the adjacent paper mill operations (I. Mendez, USACE, personal communication, January 2, 2001). This use ceased when West Linn Paper shifted product movement from barges to trucks. Today, recreational uses dominate lock operations. In 1974, Willamette Falls Locks was listed as a National Historic Landmark. It also has been designated a State Historic Civil Engineering Landmark, recognizing its significance as Oregon's first water resource development.

Recreation Uses

The working industrial complexes surrounding Willamette Falls limit direct recreational access and use; however, several recreation developments are located within or adjacent to the Willamette Falls FERC Project boundary.

Natural Resource Uses

Lands within the Project boundary are highly developed yet offer an array of terrestrial and aquatic habitat. In the vicinity of Willamette Falls, industrial buildings, bridges, walkways and other facilities occupy Project lands. The habitat is considered relatively low quality due to extensive development. A narrow strip of undeveloped land extends almost two miles upstream along the west bank of the river. This contiguous strip is interrupted in three locations by riverfront parcels owned by West Linn and Blue Heron Paper Companies. The habitat is predominantly low quality upland shrub sandwiched between the river and parking, storage areas and settling lagoons. Approximately 2.2 acres within the Project boundary are leased to the City of West Linn and managed for public access as Bernert Landing. These developed areas are low in quality due to limited habitat and high disturbance levels. Project lands extending up the Tualatin River include some wetlands and riparian forest of relatively high quality owing to species and structural diversity and lower levels of disturbance. In addition, approximately 1.2 acres of moderate quality wetland provide relatively undisturbed refuge in this area.

The rocky formations of the Falls are integral aspects of the Project. A fish ladder, owned and operated by ODFW, provides multiple entrances for upstream migrants on the western side of the Falls. In addition, ODFW operates a fish counting facility here. These features, some dating back to 1904, operate under an easement granted to the State of Oregon by PGE. Fish ladder facilities were completely rebuilt between 1966 and 1971, and more recently after the 1996 floods.

Native Americans and sport fishermen frequently use the river below Willamette Falls. In addition to salmon fishing, Native Americans harvest Pacific lamprey annually between June and August, for personal use.

Land Management Jurisdiction

Due to the size and importance of the Willamette River, over 110-land use plans from nine counties and many cities guide the management of lands within the basin (Willamette River Basin Task Force 1997, Willamette Restoration Initiative 2000). The hydropower and industrial uses described at the Project site pre-date most all of these land management planning and use designations. Locally, land management is regulated by the ordinances of the cities of West Linn and Oregon City, in addition to pertinent state and federal regulations.

Local Comprehensive Plans

West Linn—The City of West Linn has zoned the majority of the lands along the west bank of the Project area as Commercial Industrial. This designation extends approximately 1.3 miles upstream of Willamette Falls (Figure 5). Appropriate uses include manufacturing and processing. The West Linn Comprehensive Plan (2000) discusses the importance of preserving the City's natural environment. The City's goals for complying with the State's Willamette River Greenway management objectives include improving recreation opportunities along the river and promoting development of a parallel trail. Approximately 0.25 miles of riverfront, upstream of the reach zoned "industrial", is designated for single family detached residential uses (R10) (Figure 5). Further upstream, Bernert Landing and Willamette Park are zoned as parkland. Finally, along the Tualatin River, zoning is identified for medium density residential uses (R5). The entire Project area is within the 100-year floodplain designated by the Federal Emergency Management Agency (FEMA). Any development activities associated with the Project will be assessed for compatibility with these and other provisions of the West Linn Comprehensive Plan.

Oregon City—The Comprehensive Plan for Oregon City, adopted in 1982, designates the Project site as Heavy Industrial. It identifies Willamette Falls as an historic hydropower generation site that is a "significant" energy source for the future. The Plan calls the Falls "the most prominent City landmark, visible from many locations," and stipulates that "care should be taken to preserve views of the Falls, particularly in building construction, which could obstruct the view in certain locations." Goals are also established to provide flood protection, fish and wildlife habitat, economic development and recreation opportunities. No specific restrictions were identified in the Plan; nevertheless, the entire Project area is within the FEMA-designated 100-year floodplain, based on Flood Insurance Rate Maps produced in 1992. Additionally, the site is within the inundation zone of the 1996 flood and therefore was designated a Flood Management Overlay District by the City in 1999 (Ordinance 99-1013).

The Comprehensive Plan also adopts objectives that are consistent with Statewide Planning Goal No. 15 that established the Willamette River Greenway to protect and enhance the historical, agricultural, natural, recreational, scenic and economic resources of the river corridor. Commercial and industrial uses of this reach of river, particularly related to transportation, are cited as "serving a vital purpose and provide some interest to those viewing the river. These activities should continue." Lands within the Greenway boundary identified as "Conditional Uses" include three acres owned by PGE and 12 acres owned by BHPC. PGE's land is largely inaccessible to the public, and the Plan encourages continued upkeep and maintenance of this river corridor. This section of the Comprehensive Plan concludes that the existing mix of "fishing, industrial, recreational and residential uses within the Greenway are compatible" and that such diversity is allowed.

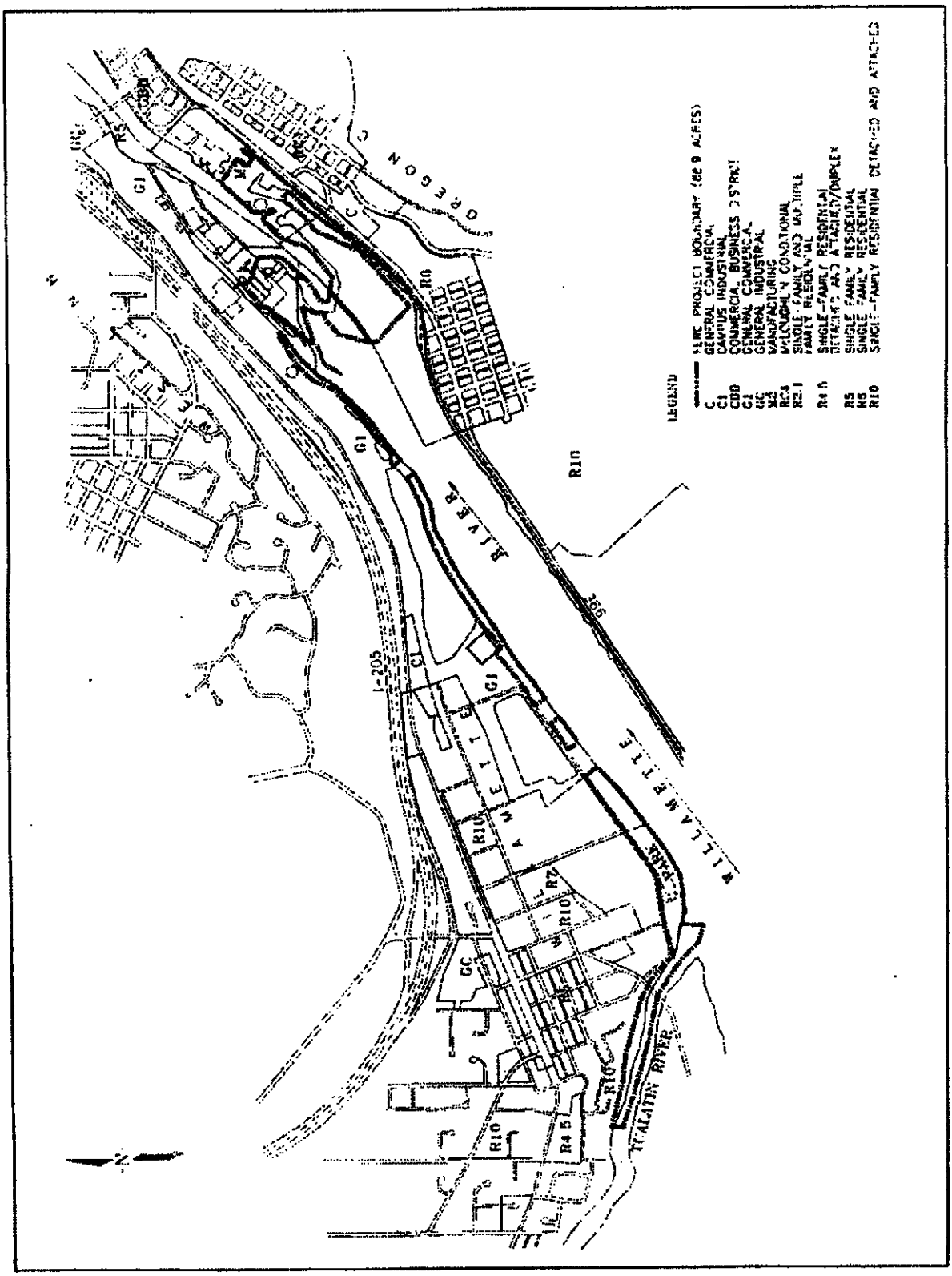

Figure 5. Land use designations, Portland General Electric

b. Environmental Impacts and Recommendations:

Issue Statement

The potential effects of the Project on recreation resources have been assessed. The consistency of the Project with local comprehensive plans, including effects on riparian zones, also has been assessed. A component of this is an assessment of existing land uses adjacent to the hydropower facilities. Dense industrial development characterizes the core of the lands within and immediately adjacent to the Willamette Falls Project, while recreational and low density mixed uses typify other portions of the surrounding area. Without implementation of the alternatives described below, these uses would be expected to continue. The Oregon City Comprehensive Plan (Oregon City 1982) and the draft West Linn Comprehensive Land Use Management Plan (West Linn 2000) would continue to dictate development opportunities.

Effects of T.W. Sullivan Forebay and Tailrace Measures (Tiers 1, 2, 3)

Each of these measures would create minor short-term impacts on local traffic and recreation patterns due to the intermittent delivery and movement of equipment and supplies. Construction-related noise would be apparent at the West Linn Paper mill and at the T.W. Sullivan plant, areas that are highly tolerant of such effects. Measures to manage these and other temporary effects would be addressed in construction specifications. Modifications to the T.W. Sullivan facility would be coordinated with local, state and federal permitting authorities, including the USACE, ODFW, the City of West Linn, and the Department of Environmental Quality.

These alternatives would have no affect on adjacent land uses or T.W. Sullivan operation, and would not affect Willamette River riparian areas, water levels, stream flows, or upstream or downstream flood protection.

Effects of Blue Heron Paper Company Shutdown

Termination of operation of the BHPC powerhouse will require shutdown of the turbines but no land disturbance. There is no effect on any adjacent land uses as a result of BHPC operational shutdowns.

Effects of Modifications to Dam

Modification of the concrete dam would create short-term impacts on local traffic and recreation patterns due to the intermittent delivery and movement of equipment, supplies, and debris. Consultation with the USACE, ODFW, the cities of West Linn and Oregon City, the ODEQ and the Oregon State Marine Board would be undertaken during design phases to ensure compliance with state and federal regulations. Staging and management of construction would be coordinated with the USACE to prevent interference with navigational access to the Willamette Falls Locks.

Depending on the final design of the controlled flow structure, construction activities also could result in minor noise disturbance throughout the construction period. These and other temporary effects would be addressed with best management practices defined in construction specifications developed for this group of options.

No localized changes in land use patterns are anticipated as a result of this group of options. These modifications would not affect Willamette River stream flows, downstream water levels, or flood protection upstream or downstream.

Effects of Recreation Measures

Recreation enhancement at Willamette Falls consists of two proposed measures, one to facilitate implementation of a trail system by the City of West Linn and the other associated with interpretative and education opportunities.

West Linn Trail Enhancements—PGE proposes to work with the City of West Linn to grant easements on Project lands along the West Linn bank of the Willamette River upstream of the Falls to facilitate the West Linn Park and Recreation Department's (WLPRD) trail development program. Granting an easement to the City of West Linn for the purpose of trail development is an appropriate recreation enhancement measure. During the course of the licensing process, several trail segments desired by WLPRD have been identified and discussed with licensing participants. These trail segments are listed below only for information and should not be interpreted as being specifically proposed by the Applicants as part of the Applicants' alternative. Any easement granted would be sufficiently conditioned so as to protect Project and paper mill operations.

Interpretive and Educational Enhancements—In each of the following interpretation and enhancement measure opportunities, the Applicants would assist and/or help fund local entities in the development of interpretive and educational opportunities related to the Willamette Falls Project, hydroelectric power, fish passage, and/or the Native American history of Willamette Falls.

- Willamette Falls Cultural and Heritage Committee (WFCHC)—The Applicants would assist the WFCHC in developing interpretive and/or educational opportunities. These opportunities could include assisting the WFCHC in obtaining space near the Project area for museum use and/or helping to develop interpretive exhibits.
- Museum of the Oregon Territory—The Applicants would assist the Museum of the Oregon Territory in developing interpretive or educational opportunities. These opportunities could include assisting the museum in developing interpretive exhibits.

These measures would have no effect on land uses. Measures that promote public awareness of the historic value of the Willamette Falls area would be consistent with components of Goal 5 of the Draft West Linn Comprehensive Plan (West Linn 2000).

c. Cumulative Effects:

The addition of fish passage facilities to the existing industrial complex at Willamette Falls, and improving migratory conditions for salmonids and lamprey, would be consistent with regional and comprehensive land management plans. These enhancement measures would reduce the contribution of existing industrial land uses to the challenges facing regionally important fish resources.

d. Recommendations:

The measures proposed by the Applicants are recommended.

e. Unavoidable Adverse Effects:

None of the proposed measures would induce unavoidable adverse effects on land uses.

Issue Statement

An understanding of why the current FERC Project boundary is so designated, specifically along the West Linn side of the river and extending upstream of the Falls, was requested during NEPA scoping meetings.

Effects of Fish Passage and Recreation Options

None of the proposed options have bearing on this informational issue. Additionally, historical records were examined and no clear reason could be identified for the delineation of the FERC Project boundary that extends upstream of the Willamette Falls on either side of the Willamette River.

D. No-Action Alternative

Under the no-action alternative, the Project would continue to operate under the terms and conditions of the existing license, any ongoing effects of the Project would continue, and no new environmental protection, mitigation, or enhancement measures would be implemented. This alternative is used only to establish the baseline environmental conditions for comparison with other alternatives. Baseline conditions are discussed at the beginning of each appropriate resource section and are summarized in the No-Action alternatives section.

Ongoing Project operations have the potential to affect water quality parameters, such as dissolved oxygen levels, gas supersaturation, temperature and sedimentation. Water quality studies have been conducted as well as computer modeling to understand the effects of the dam and seasonal flashboards on water quality parameters in the Willamette River (PGE 1998; Normandeau Associates, Inc. 2001, 2001a, 2002d, and Berger 2002).

The Project affects pool elevation to approximately RM 56. Modeling indicated that this is approximately 3 miles further upstream than if the dam and flashboards were not installed. In this case, the rock formation that forms Willamette Falls creates the backwater condition. Pool elevation can vary with river flow, but is maintained near or above 54 ft MSL, in part, to accommodate multiple water users, including Project powerhouses, the ODFW fish ladder, the USACE navigation locks, and upstream ferry operators and houseboat owners. Computer modeling indicates that travel time through the affected reach (RM 56 to RM 26.5), at approximately 5,000 cfs flow at Salem, increases from 3.0 days to 3.9 days with the dam and 4.2 days with flashboards installed. Travel time decreases with increased flows.

Water quality data collected during 2000 and 2001, and computer modeling, indicated that the seven-day running average temperature (7DMXs) of the Willamette River exceeded 20°C throughout most of the reach evaluated (RM 63.5 to RM 25.9) during nearly all of July and August in 2000 and 2001, and about 10 % of June 2001. These included sampling sites above the Project influence of RM 63.5 as well as within and below the Project pool. Lateral differences in water temperatures were small (≤2°C), based on the minimum, maximum, and mean temperatures recorded for each of the sites. Most of the monitored sites exhibited little thermal gradient, although within water column differences of more than 4.9°C occurred near RM 26.8 during mid-June 2001, late July 2000, and mid-August 2001. Analysis of the data and computer modeling indicates no thermal stratification and that the Project does not elevate summer 7DMXs in the Willamette River, and potentially provides a small benefit.

During periods in June, July and August, low DO concentrations were recorded at some monitored sites, with instances of low DO beginning around Canby Ferry (RM 41). Lateral differences in mean and maximum dissolved oxygen concentrations were small (≤0.6 ppm), although minimum concentrations varied by as much as 4.4 ppm at the Powerline and 3.2 ppm at Canby Ferry. Vertical DO stratification is not evident. Based on review of the field measurements and computer modeling, the Project does affect overall DO concentrations upstream, and in July through August when the DO standard is 6.5 mg/L, low DO occurs at a few locations that would not otherwise occur without the Project. During this period, however, the low DO conditions exist at deep holes, do not extend up into the water column, and do not persist as the water travels downstream. DO tends to decrease as water travels downstream, reflecting the fact that there is very little algal photosynthesis in the Project reach; but there is sediment oxygen demand.

Table 21 of Berger (2002) shows that mean DO levels increase by as much as .4 - .5 mg/L as river flow increases from 5,000 to 10,000 cfs.

The TDG values recorded during the 2000/2001 monitoring period (late June - early November of 2000 and May – August of 2001) remained below 110 % at all of the sites monitored with the exception of sites immediately within the horseshoe area of the Falls. TDG levels dropped below 110% immediately below the point where powerhouse discharges entered the river and diluted the high TDG water from the Falls. Additional TDG sampling done at increased winter flows measured high TDG persisting downstream of the Project for several miles when river flows exceeded approximately 30,000 cfs at the Falls. The conditions normally required for the development of these high TDG levels are not caused by the Project but instead by the naturally-occurring discharges over the Falls.

Flow velocities above the Falls typically are only capable of transporting fine sediments. Computer modeling indicated that, although the Project does reduce velocities within the affected reach, there is minimal change in the depositional rates of those sediments that do settle out. This, combined with the high variability in flows seasonally, suggest that the Project has minimal, if any, impact on sedimentation rate.

Ongoing Project operations have impacts on fish resources in the Willamette River. Installation of flashboards on Willamette Falls during early summer restores the Project pool level to approximately 54 ft. Raising water levels during this period may affect habitat for upstream resident fishes, although the additional water surface area and wetted substrate created is limited. The water surface at 54 ft elevation is expected to increase by about 1% compared to a pool level at 52 ft (Normandeau Associates, Inc. 2001d). The principal effect is to inundate sandy banks or other shore habitat upstream of the Project that may provide rearing habitat for migratory or resident juvenile fishes (Normandeau Associates, Inc. 2001d).

Ongoing operations at the Willamette Falls Project have effects on migratory fishes that pass the Project, including salmonids listed under the ESA and lamprey. During the flashboard installation process, flows over the dam are interrupted for several hours while river elevation increases to the top of the boards, during which time upstream migrating adult salmonids and lamprey can become trapped in large scour pools at the base of Willamette Falls. Anadromous species such as lamprey and adult spring chinook salmon and summer steelhead have the greatest potential to be stranded below Willamette Falls as they migrate upstream through the Project during the time when flashboard installation takes place. Although field conditions and seepage into large scour pools has made quantification difficult, annual stranding reconnaissance surveys documented small numbers of stranded adult salmonids (D. Domina, PGE, personal communication, November 12, 2001). In the past, PGE conducted salvage operations for adult salmonids, but this action was not permitted starting in 2001.

Upstream fish passage at Willamette Falls is variable by species and is affected by natural conditions (e.g., discharge, water temperatures) and attraction flows present at the fish ladder entrances. Concerns were raised that false attraction to turbine discharges may cause delays to upstream migrants by masking fishway entrance attraction flows, or potentially lead to fish injury by contact with turbine runner blades. Upstream migrants delayed in locating the ODFW ladder entrances may also be exposed to increased risk of sea lion predation. No definitive information exists to suggest that upstream migrating fish are adversely delayed or injured by the presence or operation of the Project. A pilot radio-telemetry study (19 test fish) was conducted in the spring of 2000, and a second radio-telemetry study (47 test fish) was conducted in 2001, to provide additional Project specific data on upstream passage delay and injury. These data indicated that there was delay at Willamette Falls, but that is did not appear to be due to Project operations. Additionally, T.W. Sullivan draft tubes were monitored to determine the potential for death or injury due to migrating salmon entering the tubes and contacting turbine blading or other bracing. The study indicated that this was not a problem at T.W. Sullivan and geometry of the BHPC draft tubes suggests that this is not a concern there either.

The Willamette Falls Project ongoing operations have resulted in entrainment impacts to downstream migrating fishes, including ESA-listed salmonids. Estimated impacts at T.W. Sullivan to downstream migrating salmonids ranges from 4.5% to 14.8% direct mortality, and approximately 1.2% to 1.3% indirect mortality associated with predation (Normandeau Associates 2001h). The BHPC development is shut down for 16 weeks during the spring outmigration period, but does have entrainment impacts during the period of operation. Mortality for those smolts that do enter the BHPC development during operational periods was estimated at 18.7% (Normandeau Associates, Inc 2001b). Estimated impacts are higher for those species/stocks with a protracted smolt run or that migrate during lower flow periods (e.g., natural steelhead, fall chinook salmon, natural spring chinook salmon). Participants during relicensing, while not all agreeing on the impact estimates at T.W. Sullivan and BHPC, did agree that the current mortality levels should be improved.

There is no site-specific baseline data quantifying mortality impacts associated with the Willamette Falls, or the dam that is located around the crest of the Falls. Potential impacts to fish passing over the dam are inseparable from impacts associated with passing over the natural portion of the Falls and no pre-Project data are available for an assessment of current versus historic effects. Participants during relicensing agreed that fish passage conditions over the Falls required improvement.

Ongoing use of Project lands has indirect effects on wildlife. Indirect effects on Project lands above the Falls include habitat loss, fragmentation and disturbance resulting from industrial use. The impact of these land uses on wildlife does not appear to be substantially different from impacts that are occurring on adjacent ownerships, and throughout the lower Willamette basin.

Installation of flashboards causes an increase in surface elevation that inundates soils that would otherwise be exposed during several months of the late summer and early fall. The resulting effect is a shortened "low-flow" condition (i.e., low river elevation) period. In the Project area and further upstream, riparian vegetation is dominated by species (alder, cottonwood, willow, dogwood, salmonberry) that can tolerate a variety of moisture conditions, including brief winter flooding and low summer flows. Thus, the direct impact of Project operation on vegetation is expected to be minor. The effects of pool elevation on riparian and shallow water habitat are also thought to be minor (Normandeau Associates, Inc. 2001d).

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VI. DEVELOPMENTAL ANALYSIS

In this section, we analyze the Project's use of the water resources of the Willamette River to generate power, estimate the economic benefits of the Willamette Falls Project, and estimate the cost of various environmental protection and enhancement measures and the effects of these measures on project operations.

Under its approach to evaluating the economics of hydropower projects, as articulated in Mead Corporation, Publishing Paper Division (72 FERC ¶ 61,027, July 13, 1995), the Commission employs an analysis that uses current costs to compare the costs of the project and likely alternative power with no consideration for potential future inflation, escalation, or deflation beyond the license issuance date. This economic analysis provides a general estimate of the potential power benefits and costs of a project and reasonable alternatives to project-generated power. The estimate helps to support an informed decision on what is in the public interest with respect to a proposed license.

For our economic analysis of alternatives, we used the assumptions, values, and sources shown in table 18.

Table 18. Staff assumptions for economic analysis of the Willamette Hydroelectric Project. (Source: Staff)

Assumption	Value
Energy value[a]	32 mills/kWh
Capacity value[b]	$99/kW-year
Period of analysis	30 years
Term of financing	20 years
Cost of capital	8 percent
Discount rate	8 percent
Federal income tax rate	34.0 percent
Local tax rate	3 percent
O&M costs[c]	$673,000
Net investment[d]	$8,631,000

[a] From Exhibit A, License Application (PGE, 2002a).

[b] Capacity value estimate by staff based on cost of combined cycle combustion turbine.

[c] From Exhibit D, License Application (PGE, 2002a). Includes the following administrative fees: $13,907 for headwater benefits paid to BPA; $43,650 for annual fees paid to FERC; and $16,233 for power claim fees paid to State of Oregon.

[d] The net investment in PGE's existing T.W. Sullivan development, as of December 31, 2002, is approximately $8,631,000. BHPC does not track its net investment in its hydroelectric development. (PGE, 2002a).

A. Power and Economic Benefits of the Proposed Project

In an August 28, 2003, supplement to its license application and preliminary draft environmental assessment, PGE provided a description and cost estimate for a preferred alternative set of resource enhancement and protection measures it would implement under a new license for the Willamette Hydroelectric Project. PGE filed an Offer of Settlement on February 2, 2004, which reflects the preferred alternative in both the DEA and this FEA.

Under the preferred alternative, PGE would cease to operate the BHPC powerhouse and would undertake in-place decommissioning of the development by 2005. This measure would reduce the project's installed capacity by 1.5 MW, resulting in a new project capacity rating of 16.0 MW, all of which would be provided by the T.W. Sullivan development.

PGE's preferred alternative includes numerous measures for the enhancement and protection of fish. PGE estimates the total capital cost of implementing fish enhancement measures (itemized in the section below) would be $7,045,000 and the total additional operation and maintenance cost would be $218,500, annually. In addition to fish enhancements, PGE proposes to implement or fund cultural interpretive program improvements costing an estimated $250,000 initially and $50,000 per year for a period of 5 years. Other than retiring the BHPC development, none of the proposed measures would significantly affect the amount of generation and dependable capacity at the T.W. Sullivan development.

As proposed by PGE, under the preferred alternative the Willamette Hydroelectric Project would generate an average of approximately 121,471 MWh of electricity annually, have an annual power value of $5,273,000 ($43/MWh), and total annual costs of $2,662,000 ($22/MWh), resulting in a net annual benefit of $2,611,000 (about $21/MWh).

B. Cost of Environmental Measures

The preferred alternative includes improvements to the T.W. Sullivan powerhouse, the dam (located at the top of Willamette Falls) and the state-owned fish ladder. Tables 19 through 21 below provide PGE's estimated costs of preferred alternative measures at the Willamette Falls Project. Capital as well as an annual O&M cost estimates for each measure is provided. Based on PGE's estimates, we computed the levelized annual cost of each measure over the 30-year period of our analysis. The total estimated cost for the above measures, in 2003 dollars, is $7,295,000 capital and $268,500 annual O&M.

Table 19. Estimated costs of proposed measures at the T.W. Sullivan Powerhouse.

Proposed Measures at the T.W. Sullivan Powerhouse	**Capital Cost (2003$)**	**Annual O&M Cost (2003$)**	**Levelized Annual Cost (2003$)**
Modify forebay trashracks and guidewall	$500,000	$15,000	$65,800
Construct siphon spillway fish bypass	$650,000	$20,000	$86,000
Trash rack cleaning system	$350,000	$10,500	$46,000
Modify Units 12 and 13 Turbine Discharges	$250,000	$7,500	$32,900
Avian predation deterrent upgrades	$10,000	$1,000	$2,000
New PIT technology unit 13 and siphon bypass	$35,000	$1,500	$5,000
Modify Unit 13 Bypass System Outfall	$500,000	$15,000	$65,800
Operate within 1% peak efficiency - existing runners (4yrs)		$12,000	$3,500
Index test new runners (assume 1 tested)	$200,000		$20,300
Mortality test new runner design (assume 1 tested)	$200,000		$20,300
Juvenile lamprey and fry impact assessments (includes Eicher impingement)	$50,000		$5,100
Auxiliary flow system for ladder at Unit 1 in lieu of powerhouse s/d if unit 1 offline > 24hrs	$200,000	$2,000	$22,300
T.W. Sullivan Powerhouse total	**$2,945,000**	**$84,500**	**$375,000**

Table 20. Estimated costs of proposed measures at Willamette Falls and Fish Ladder.

Proposed Measures at the Willamette Falls / Fish Ladder	**Capital Cost (2003$)**	**Annual O&M Cost (2003$)**	**Levelized Annual Cost (2003$)**
Controlled flow structure at apex of falls (Based on notching the dam and associated structures. Cost based on 150' x 10' notch)	$2,000,000	$60,000	$263,200
Minor improvements to landing associated with controlled flow structures (10% of structure cost)	$200,000	$3,000	$23,300
Short-term upstream lamprey passage structure and testing (3-years)	$10,000	$5,000	$2,200
Notches in flashboards for stranding hole flows		$1,000	$1,000
Provide stranding hole egress channels ($5k/yr accrued life of license)	$150,000		$15,200
Eliminate "Wet Hole" egress blockage	$80,000		$8,100
Fish Ladder ongoing O&M (capital is estimate for equipment replacements)	$100,000	$60,000	$70,200
Fish Ladder backlog Projects	$150,000		$15,200
Additional Fish Ladder Projects (or $100k Lamprey research if outside funded)	$200,000		$20,300
Ladder entrance #1 modifications	$300,000		$30,500
Ladder modifications for lamprey passage	$75,000		$7,600
Dam structure modifications for lamprey passage	$75,000	$2,500	$10,100
Avian predation deterrent devices	$10,000	$2,500	$3,500
Lamprey Salvage Program ($5k/year for estimated 10 yrs))	$50,000		$3,000
Willamette Falls / Fish Ladder total	**$3,400,000**	**$134,000**	**$473,400**

Table 21. Estimated costs of other proposed measures.

Other Proposed Measures	Capital Cost (2003$)	Annual O&M Cost (2003$)	Levelized Annual Cost (2003$)
Adult Pacific lamprey research funding	$200,000		$20,300
Miscellaneous modeling and post construction assessments	$500,000		$50,800
Cultural and historic interpretive improvements for Recreation Resource enhancement	$250,000	$50,000 (5 years)	$40,600
Other Measures total	**$950,000**	**$50,000**	**$91,400**

C. No-Action Alternative

Under the no-action alternative the Project would remain in operation and none of the proposed environmental enhancement measures would be implemented. The project would continue to operate as it has in the past, generating an average of 129,456 MWh of electricity annually. Under the no-action alternative and based on the economic parameters listed in table 18, the Willamette Falls Project has an annual power value of $5,528,000 ($43/MWh), and total annual costs of $1,699,000 ($13/MWh), resulting in a net annual benefit of $3,829,000 ($30/MWh).

D. Greenhouse Gas

By producing hydroelectricity the Willamette Falls project displaces the need for other power plants, primarily fossil-fueled facilities, to operate, thereby avoiding some power plant emissions and creating an environmental benefit. If the electric generating capacity of the project were replaced with other fossil fuels, greenhouse gas emissions could potentially increase by 19,000 metric tons of carbon per year.

VII. COMPREHENSIVE DEVELOPMENTAL ANALYSIS

Sections 4(e) and 10(a)(1) of the FPA require that the Commission give equal consideration to all uses of the waterway on which the project is located. When we review a hydropower project, we consider the water quality, fish and wildlife, recreational, cultural, and other non-developmental values of the waterway equally with its electric energy and other developmental values. In determining whether, and under what circumstances, to license a project, the Commission must weigh the various economic and environmental tradeoffs involved in the decision.

Based on our independent review and evaluation of the originally proposed action, the currently proposed Settlement Agreement, and no action, we recommend licensing the project as currently proposed by PGE in the Settlement Agreement. We recommend

this alternative because: (1) the project would provide a significant and dependable source of electrical energy for the region; (2) the project would avoid the need for an equivalent amount of fossil-fuel-fired, electric generation and capacity, thereby continuing to help to conserve these non-renewable energy resources and reduce atmospheric pollution; and (3) the recommended environmental measures would adequately protect and/or enhance aquatic, terrestrial, recreational, and cultural resources.

The environmental measures we recommend are those proposed by PGE in the Settlement Agreement as specified in section III.B of this FEA

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VIII. RECOMMENDATIONS OF FISH AND WILDLIFE AGENCIES

Section 10(j) of the FPA requires the Commission to include license conditions, based on recommendations provided by the federal and state fish and wildlife agencies for resources affected by the project. Section 10(j) states that whenever the Commission believes that any fish and wildlife agency recommendation is inconsistent with the purposes and requirements of the FPA, or other applicable law, the Commission and the agency shall attempt to resolve any such inconsistency.

NOAA Fisheries and Interior filed comments on the application, recommendations, terms and conditions, and prescriptions on May 30, 2003. ODFW filed comments on the application and recommendations on May 29, 2003. On March 1, 2004, ODFW timely modified their recommendations to include, by reference, 19 proposed license articles included with the Settlement Agreement filed by PGE on February 2, 2004. We address the concerns of the federal and state fish and wildlife agencies in the FEA and adopt all recommendations that fall within the scope of section 10(j). Recommendations that we consider outside of the scope of section 10(j) of the FPA have been considered under section 10(a) of the FPA and are addressed in the specific resource sections of this document.

Table 22 lists the recommendations originally submitted by Interior, NOAA Fisheries, and ODFW under section 10(j). Table 22 also summarizes our analysis of those recommendations, including whether the staff recommends adopting the measures.

In section VII of this FEA, staff recommends the Settlement Agreement measures as specified in section III.B of this FEA, which is consistent with the modified recommendations submitted by ODFW on March 1, 2004.

Table 22. Analysis of fish and wildlife agency recommendations for the Willamette Falls Project. (Source: Staff).

Recommendation	Agency	Within scope of section 10(j)?	Annual cost	Recommend adopting?
1. Develop and implement a plan to compensate for ongoing and avoidable losses associated with the continued presence and operation of the Project.	Interior NOAA Fisheries	No, not a specific measure to protect, mitigate or enhance fish and wildlife resources.	$10,000[a]	Not adopted. Subsequent negotiations with PGE resulted in a Settlement Agreement that resolved all of the agencies' fish and wildlife concerns.
2. Take immediate appropriate action	Interior ODFW	Yes	Minimal	Yes.

Recommendation	Agency	Within scope of section 10(j)?	Annual cost	Recommend adopting?
during Project emergencies to prevent further fish losses.				
3. Provide funding and administrative support for the FTS.	Interior	No, not a specific measure to protect, mitigate, or enhance fish and wildlife resources.[b]	Minimal	Yes; however, we recommend funding the FTS, other than the agencies' administration and support costs.
4. Consult directly with the FWS regarding the completion of project plans and designs for measures to protect, mitigate damages to, and enhance fish and wildlife resources.	Interior	No, not a specific measure to protect, mitigate, or enhance fish and wildlife resources.[b]	Minimal	Yes.
5. Upon project abandonment, remove or modify project facilities and restore site as recommended by federal and state agencies to maintain fish and wildlife production in the Project affected area.	Interior ODFW	No, not a specific measure to protect, mitigate, or enhance fish and wildlife resources.[b]	Cannot be specified, because it's unclear which facilities would ultimately be removed or modified.	Not adopted. Agencies could make recommendations to the Commission to protect fish and wildlife, but the Commission would retain authority for setting final measures to be implemented.
6. Include a specific ESA license reopener to require license amendments	NOAA Fisheries ODFW	No, not a specific measure to protect, mitigate, or	Minimal	Not adopted; however, agencies could use a standard

Recommendation	Agency	Within scope of section 10(j)?	Annual cost	Recommend adopting?
or project modifications to comply with the ESA following reinitiation of ESA Section 7 consultation.		enhance fish and wildlife resources.		license article, included in all licenses, to petition the Commission to reopen the license.

[a] Estimated total cost of developing this plan only.

[b] Filed by Interior as a Section 10(a) recommendation.

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IX. CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10 (a)(2)(A) of the Federal Power Act requires the Commission to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing or conserving waterways affected by the Project. Accordingly various agencies have filed comprehensive plans that address resource issues in Oregon. Of these, the plans listed below are relevant to the Project area and were reviewed to determine whether the continued operation of the Willamette Falls Project would be consistent with their provisions. We conclude that the proposed project would not conflict with these plans.

- *Northwest Conservation and Electric Power Plan*, 1991, Northwest Power Planning Council, Portland, Oregon.
- Columbia River Basin Fish and Wildlife Program, 1984, 1987, 1994 and 2000, Northwest Power Planning Council, Portland, Oregon.
- Comprehensive Plan for Protection and Management of Oregon's Anadromous Salmon and Trout Part I, 1982, Oregon Department of Fish and Wildlife.
- Comprehensive Plan for Protection and Management of Oregon's Anadromous Salmon and Trout Part II. Coho Salmon Plan, 1982 Oregon Department of Fish and Wildlife.
- Comprehensive Plan for Production and Management of Oregon's Anadromous Salmon and Trout, Part III: Steelhead Plan,1995, Oregon Department of Fish and Wildlife.
- Species at Risk: Sensitive, Threatened, and Endangered Vertebrates of Oregon, 1996, Oregon Department of Fish and Wildlife
- Upper Willamette Subbasin Fish Management Plan, 1992, Oregon Department of Fish and Wildlife.
- Biennial Report on the Status of Wild Fish in Oregon, 1995, Oregon Department of Fish and Wildlife.
- The Statewide Trout Management Plan, 1987, Oregon Department of Fish and Wildlife.
- Oregon Plan for Salmon and Watersheds, Supplement 1: Steelhead,1997, Oregon Department of Fish and Wildlife.
- Upper Willamette River Winter Steelhead in Sport Fisheries of the Upper Willamette Basin, 2001, Oregon Department of Fish and Wildlife.

- Upper Willamette River Spring Chinook in Freshwater Fisheries of the Willamette Basin and the Lower Columbia River, 2001, Oregon Department of Fish and Wildlife.
- A Proposal for the Willamette River Greenway, 1976, Oregon State Parks and Recreation Branch of the Department of Transportation.
- Statewide Water Quality Management Plan, 1978, Oregon Department of Environmental Quality.
- Protected Areas Amendments and Reponse to Comments: Oregon, 1988, Northwest Power Planning Council, Portland, Oregon.
- Oregon Statewide Comprehensive Outdoor Recreation Plan 2003-2007, Oregon State Parks and Recreation Branch of the Department of Transportation.

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X. FINDING OF NO SIGNIFICANT IMPACT OR OF SIGNIFICANT IMPACT

Implementing the enhancement measures described in this FEA would ensure that the environmental effects of continued project operation would be insignificant. On the basis of our environmental analysis, issuance of a new license for the Willamette Falls Project with staff-recommended measures and other special license articles would not constitute a major federal action significantly affecting the quality of the human environment.

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XIII. APPENDIX A RESPONSE TO COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT

Portland General Electric

Comment #1. PGE noted that the DEA, issued January 23, 2004, was issued before Commission staff could incorporate the final details contained in their filing of an Offer of Settlement on February 2, 2004. Because of this, the DEA did not include the precise terms of the Settlement Agreement. However, PGE is satisfied that the description of the proposed action contained in the DEA is generally consistent with the Settlement Agreement, which provides the detailed terms and conditions required for implementation. The Settlement Agreement provides additional details, but does not differ in any significant way from the analysis contained in the DEA. PGE and Commissioin staff believe there is no need to modify the FEA to reflect the precise terms of the Settlement Agreement. Instead, PGE recommended that Commission staff only modify the FEA to include reference to the Settlement Agreement and adopt language consistent with the language of the Settlement Agreement and Proposed License Articles, which are contained in Appendix A of the February 2, 2004, filing.

Response #1. *We concur with PGE's comment. References to the filing of the Settlement Agreement are contained throughout this FEA. We recommend in this FEA conditions consistent with the Settlement Agreement, with Commission approval as appropriate.*

Oregon Hydroelectric Application Review Team

Comment #1. FERC's final environmental analysis should reflect the proposed license requirements set forth in the Settlement Agreement, Proposed License Articles, and Relicensing Implementation Plan. ODFW modified its Section 10(j) recommended terms and conditions to incorporate by reference the Proposed License Articles 1 through 19 attached to the Settlement Agreement as Exhibit A.

Response #1. *See our response to Portland General Electric's comment # 1. References to the filing of the Settlement Agreement and Proposed License Articles are contained througout this FEA.*

Comment #2. The Oregon state agencies offered comments on the Biological Evaluation/Assessment attached to the DEA as Exhibit A. They remind the Commission staff that the final determination regarding water quality impacts, if any, will be made by ODEQ in its Section 401 certification determination.

Response #2. *We understand that ODEQ has not issued Section 401 Certification, to* date. *Text is added in section V.C.2.b of the FEA stating that the Oregon state agencies believe the Settlement Agreement filed on February 2, 2004, is in the public interest.*

U.S. Department of the Interior (U.S. Fish and Wildlife Service)

Comment #1. FWS noted that the DEA did not include all of the terms and conditions outlined in the final Settlement Agreement. They recommend that the Commission adopt the complete proposal and specific language in the Settlement Agreement in its entirety as the Preferred Alternative for the FEA.

Response #1. *We added text in the FEA to reflect the FWS letter filed on March 3, 2004, which supports the Settlement Agreement filed on February 2, 2004.*

American Rivers, Oregon Trout, Trout Unlimited, and the Native Fish Society

Comment #1. The Conservation Groups strongly support the Settlement Agreement.

Response #1. *We added text in the FEA reflecting support for the Settlement Agreement.*

NOAA Fisheries

Comment #1. NOAA Fisheries determined that the Settlement Agreement would provide greater protection to listed chinook salmon and steelhead than that described in the DEA/BA and encourages FERC to adapt this alternative in the FEA. NOAA Fisheries will wait until after the issuance of this FEA to respond to the Commission's February 4, 2004, letter requesting consultation under the Endangered Species Act.

Response #1. *We added text in the FEA reflecting support for the Settlement Agreement.*