HENRY M. JACKSON HYDROELECTRIC PROJECT
FERC No. 2157

APPLICATION for NEW LICENSE
MAJOR PROJECT - EXISTING DAM

18 CFR, PARTS 4 AND 5, SUBPART F, SECTION 4.51

VOLUME I, PART 2 of 2

EXHIBIT E

Public Utility District No. 1
of Snohomish County

SNOHOMISH COUNTY PUD PUBLIC UTILITY DISTRICT No. 1

May 29, 2009

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Acronyms and Abbreviations

APE	Area of Potential Effects
AR	At Risk
ARC	Aquatics Resource Committee
ACSR	Aluminum Conductor Steel Reinforced
ATV	all-terrain vehicles
BPA	Bonneville Power Administration
BIBI	Benthic Invertebrate Index of Biological Integrity
°C	Degrees Celsius
cfs	cubic feet per second
CFU	colony-forming unit
City	City of Everett
CO_2	Carbon dioxide
CRG	Cultural Resources Group
CWA	Clean Water Act
CWD	Coarse Woody Debris
CZMA	Coastal Zone Management Act
DAHP	Washington Department of Archaeology and Historic Preservation
dbh	diameter at breast height
DC	direct current
District	Public Utility District No. 1 of Snohomish County, Washington
DNR	Washington Department of Natural Resources
DO	Dissolved Oxygen
DPS	Distinct Population Segment
EA	Environmental Assessment
Ecology	Washington Department of Ecology
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
FPA	Forest Practices Act
FPR	Forest Practices Rules
FR	Forest Road
Ha	Hectares
HCP	Habitat Conservation Plan
HEP	Habitat Evaluation Procedure
HGMP	Hatchery Genetic Management Plan
HMI	human-machine interface

hp	horsepower
HPMP	Historic Properties Management Plan
HSI	Habitat Suitability Index
HSRG	Hatchery Scientific Review Group
Hz	hertz
I-5	Interstate 5
IAC	Interagency Committee for Outdoor Recreation
IEP	Interpretation and Education Program
IHA/RVA	Indicators of Hydrologic Alteration/Range of Variability Analysis
ILP	Integrated Licensing Process
Joint Agencies	Washington Department of Fish and Wildlife, National Marine Fisheries Service, and Tulalip Tribes
kv	kilovolt
kW	Kilowatt
kWh	Kilowatt hours
LSR	Lake-successional reserve
LWD	Large Woody Debris
mgd	million gallons per day
Mg/L	Milligrams per Liter
mm	Millimeters
MMHPP	Marbled Murrelet Habitat Protection Plan
MOCA	Mapped Owl Conservation Area
MPC	Main Plant Controller
MSA	Magnuson-Stevens Act
msl	mean sea level
MVA	megavolt amperes
MW	Megawatt
MWa	average megawatts
MWh	Megawatt hour
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NF	North Fork Sultan River
NFS	National Forest System
NGO	non-governmental organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPF	not properly functioning
NR	National Register
NRCA	Natural Resources Conservation Area
NTU	nephelometric turbidity units
NWMP	Noxious Weed Management Plan

OMP	Operations and Maintenance Program
OR	Operational Reach
PAD	Pre-Application Document
PCE	Primary Constituent Element
PFMC	Pacific Fisheries Management Council
PFC	Properly Functioning Condition
PFR	Process Flow Release
PHS	Priority Habitats and Species
PK-ML	Pilchuck Mainline
PLC	Programmable logic controls
PLP	Preliminary License Proposal
PM&E/PME	Protection, mitigation and enhancement
PNCA	Pacific Northwest Coordination Agreement
PR	Process Reach
Project	Henry M. Jackson Project
PUD	Public Utility District
Qbf	bankfull flow
REA	Ready for environmental analysis
RM	River Mile
RMAP	Road Maintenance and Abandonment Plan
ROW	Right-of-Way
rpm	revolutions per minute
RRMP	Recreation Resources Management Plan
RSP	Revised Study Plan
RSUAP	Recreation Sites Use Areas Program
SCADA	Supervisory Control Data Acquisition
SCE	side channel enhancement
SD	Scoping Document
SF	South Fork Sultan River
SHPO	State Historic Preservation Officer
SLRFP	Spada Lake Recreational Fishery Plan
SSTEMP	Stream Segment Temperature Model
TCP	Traditional Cultural Properties
TDG	total dissolved gas
TDS	total dissolved solids
TP	total phosphorus
TPH	total petroleum hydrocarbons
TRMP	Terrestrial Resource Management Plan
TU	Temperature Units
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

USGS	United States Geological Survey
WAC	Washington Administrative Code
WC	Williamson Creek
WDFW	Washington Department of Fish and Wildlife
WDG	Washington Department of Game
WHMP	Wildlife Habitat Management Plan
WNHP	Washington's Natural Heritage Program
WR Plan	Whitewater Recreation Plan
WTC	Water Temperature Conditioning
WUA	Weighted Usable Area

EXECUTIVE SUMMARY

The Henry M. Jackson Project (Project) is located on the Sultan River, approximately 24 miles east of Everett, Washington, in south central Snohomish County. The Project has an installed capacity of 111.8 megawatts (MW). Project facilities currently include Spada Lake (the Project reservoir), Culmback Dam, the power conduit and Powerhouse, the Lake Chaplain pipeline, Portal 2 structure, the City of Everett's (City's) Diversion Dam, the Diversion Dam tunnel and pipeline from Lake Chaplain to a new minimum flow discharge structure, and a 1-mile-long transmission line extending from the power plant switchyard to the Lake Chaplain Substation. The Jackson Project is operated to provide water for municipal water supply, minimum instream flows to protect aquatic resources, power supply, and incidental winter flood storage.

The current license for the Project expires on May 31, 2011. The Snohomish County Public Utility District (District) and the City are co-licensees during the current license term; however, the District will be the sole licensee during the new license term. The District has followed the Commission's Integrated Licensing Process (ILP). The District filed a Pre-Application Document (PAD) on December 1, 2005, outlining existing information about the Project and providing the basis for the scoping process. During scoping, the District and stakeholders identified several resource issues associated with the Project. The District consulted with the stakeholders to develop plans for 22 technical studies targeting Project operations; geomorphology; water resources; fisheries; noxious weeds; wildlife habitat; rare, threatened, and endangered species; recreation; and cultural resources. Studies were conducted between 2006 and 2009. The District used the results of these studies and stakeholder consultation to develop a Preliminary Licensing Proposal (PLP), which was filed with the Commission on December 31, 2008. Stakeholder comments on the PLP and comments received from continuing consultation have been incorporated into the Final License Application (FLA), including this Exhibit E, which is being filed with the Commission on May 29, 2009.

This Exhibit E evaluates the potential natural resource benefits, environmental impacts, and economic costs of the District's proposed action, and compares them to the effects of continuing to operate the Project as currently licensed (i.e., the no action alternative). The District and stakeholders are engaged in settlement negotiations that may include alternatives to the proposed action.

With this relicensing, the District is proposing to modify the Project boundary to include all lands necessary to Project operation and exclude lands that are not necessary to Project operation. As a result of this proposal, four wildlife management tracts and all Project-related recreation sites would be incorporated into the Project boundary, while the City's Diversion Dam would be removed from it.

Under the proposed action, the District would implement a new Operations Plan based on revised Spada Lake reservoir rule curves. The District moderately revised the current license rule curves to prevent or reduce the risk of spill following Chinook fall spawning. The rule curves will continue to provide for a reliable municipal water supply, incidental winter flood storage, power supply for the District and minimum instream flows to support aquatic resources.

The proposed action would include a new Project feature related to Project operations. The District is installing a governor control system to bypass the Pelton turbine needle valve flow to the Sultan River in order to reduce the potential for an immediate reduction in Sultan River flow caused by inadvertent turbine or generator shutdown.

The District's proposed protection, mitigation and enhancement measures (PM&Es) address the primary concerns identified during scoping. These include water quality protection and temperature conditioning; provision of minimum instream flows, process flows, and juvenile outmigration and adult upstream migration flow releases; large woody debris placement; side channel enhancement; recreational fishery management; noxious weed management; wildlife habitat management; protection of listed species; evaluation of whitewater boating opportunities; recreation resource management; and historic properties management.

Developmental analysis of the proposed action shows the annual net benefit of the proposed action would be $25,824,626. The annual net benefit of the no action alternative would be $25,705,954. While the proposed action has a higher economic cost than continuing to operate the Project as licensed, the District believes the operational improvements and the environmental benefits to natural resources, recreation, and cultural values of this alternative outweigh the cost.

E.1 APPLICATION

E.1.1 Relicensing Process

Public Utility District No. 1 of Snohomish County (District) and the City of Everett (City) formally initiated the relicensing process for the Henry M. Jackson Hydroelectric Project (Project) on December 1, 2005, by filing a Notice of Intent to seek a new operating license and a Pre-Application Document (PAD) describing the existing Project and environment. Between 2006 and 2009 the District conducted 22 studies to investigate the potential effects of continuing operation of the Project on natural and social resources (see Table E.1.1-1); held numerous stakeholder and resource group meetings; and developed protection, mitigation and enhancement measures (PM&Es) to address the potential effects of ongoing Project operation.

The District and the City entered into an agreement in 2007 in which the District would be the sole applicant for a new license under the Federal Power Act. Both the District and City petitioned the FERC to issue a declaratory order finding that the District has sufficient rights to use those of the City's properties and facilities that are necessary for Project purposes and that the City need not be a co-applicant for a new license to operate the Project. FERC approved this request on December 20, 2007. This Final License Application (FLA) Exhibit E presents the District's proposed protection, mitigation and enhancement measures (PM&Es) for the term of a new operating license. The District believes that these measures adequately address the effects of the Project on the surrounding environment. Although there are still several unresolved issues to work through with the stakeholders, the District is committed to continuing settlement discussions to resolve these outstanding issues. Because these discussions are on-going, the FLA presents the District's proposed alternative for the continued operation of the Project under the terms of a new license.

Table E.1.1-1 Studies completed as part of Project relicensing.

Study Plan #	Study Plan Title	Final Technical Report Complete[1]
RSP 1	Water Quality Parameter Study	July 2009
RSP 2	Bypass Reach Cutthroat Trout Population Analysis	June 2008
RSP 3	Sultan River Instream Flow Study	May 2009
RSP 4	Assessment of Spada Lake Fish Entrainment	December 2007
RSP 5	Juvenile Fish Abundance, Life History and Distribution	May 2009
RSP 6	Habitat Management Methods Literature Review and Evaluation	November 2007
RSP 7	Special Status Plant Surveys	February 2008
RSP 8	Noxious Weed Inventory	February 2008
RSP 9	Wetlands Survey	October 2008
RSP 10	Amphibian Survey	October 2008
RSP 11	Marbled Murrelet Surveys	October 2008
RSP 12	Northern Spotted Owl Surveys	October 2008

Study Plan #	Study Plan Title	Final Technical Report Complete[1]
RSP 13	Recreation Needs Analysis	October 2008
RSP 14	Flow Recreation Study	July 2008
RSP 15	Historic Properties Study	March 2008
RSP 16	Spada Lake Trout Production	August 2008
RSP 18	Riverine, Riparian and Wetland Habitat Assessment of the Sultan River below Culmback Dam	March 2008
RSP 20	Fish Passage Assessment	Phase 1: January 2008 Phase 2: May 2009
RSP 21	Flow Continuation Alternatives and Feasibility at the Powerhouse	October 2008
RSP 22	Sultan River Physical Process Studies	June 2008, October 2008
RSP 23	Indicators of Hydrologic Alteration/Range of Variability Analysis (IHA/RVA) in the Sultan River Downstream of Culmback Dam	January 2008
RSP 24	Marsh Creek Slide Modification Assessment to Improve Fish Passage	May 2009

[1]Technical reports were finalized after a 30-day review and comment period. Final technical reports are posted to the relicensing web site.

E.1.2 Post-Filing Process and Schedule

Following filing of this FLA, FERC will undertake its review of the information in accordance with the Federal Power Act, National Environmental Policy Act (NEPA), and other federal laws relevant to the relicensing of a hydroelectric project. FERC's preliminary plan and schedule for the post-filing activities are shown in Table E.1.1-2.

Table E.1.1-2 Preliminary post-filing processing schedule as developed by FERC.

Responsible Entity	Post-Filing Milestone	Date[1]	FERC Regulation	Process Days
FERC	Issue Public Notice of License Application Filing (Tendering Notice)	6/13/09	5.19	14 days from filing
FERC	Director's Determination on Any Additional Study Requests and Notification of Any Deficiencies	6/29/09	5.19(e); 5.20(a)(2)	30 days from filing
FERC	Issue Public Notice Accepting Application and Ready for Environmental Analysis (REA)	7/29/09	5.22	60 days from Tendering Notice
All stakeholders	Comments, Interventions, 10(a) Recommendations Due	9/27/09	5.23(a)	60 days from REA
Agencies	10(j) Recommendations; 4(e) Terms and Conditions; Fishway Prescriptions Due	9/27/09	5.23(a)	60 days from REA

Responsible Entity	Post-Filing Milestone	Date[1]	FERC Regulation	Process Days
District	Request 401 Water Quality Certification from Ecology	9/27/09	5.23(b)	60 days from REA
District	Reply Comments Due	11/11/09	5.23(a)	105 days from REA
FERC	Issue Single Environmental Assessment (EA)[2]	3/11/10	5.24	120 days from REA response due date
All stakeholders	Single EA Comments Due	4/10/10	5.24(c)	30 days after EA
Agencies	USFS Modified 4(e) Terms and Conditions Due; USFWS Modified Fishway Prescriptions Due	6/9/10	5.24(d)	60 days from EA comment due date
USFWS/NMFS	ESA Biological Opinion As Needed	7/24/10	ESA	135 days from EA
Ecology	Issue water quality certification	9/27/10	5.23(b)(2)	365 days from request for certification
FERC	Issue License Order	8/8/10	FPA	assumes 18 months from filing

[1] If the due date falls on a weekend or holiday, the due date is the following business day.
[2] This schedule assumes FERC will issue a "single" EA (without a draft EA). If FERC determines that a draft EA is needed, the post-filing timeframes will be modified accordingly.

E.2 PURPOSE OF ACTION AND NEED FOR POWER

E.2.1 Purpose of Action

The goal of this relicensing process is to obtain a new 50-year federal license for the Henry M. Jackson Hydroelectric Project that will allow the District to continue to operate the Project in an economically feasible manner and protect the high quality public water supply in balance with fish, wildlife, recreation, and cultural resources. To accomplish this goal, the District identified the following objectives:

- Provide a reasonable balance of water supply, power and environmental values such as fish, wildlife and recreation.
- Ensure that the City of Everett's public water supply needs can be met into the future.
- Continue to manage the Project in a manner that protects the fishery resources in the Sultan River.
- Continue to provide recreational opportunities consistent with regional demand.
- Continue to protect terrestrial resources consistent with FERC-approved plans.

- Ensure that the Project provides an affordable power supply to the communities in the District's service territory.
- Obtain a license that allows sufficient operational flexibility and capacity to help provide long-term economic benefit and stability for the communities served by the District.
- Continue to generate electricity from a clean, renewable resource.
- Provide incidental flood management to reduce the magnitude and frequency of flood events and their detrimental effects to downstream communities and aquatic resources.

E.2.2 Need for Power

All of the power generated by the Project is used within the District's service territory. The current average annual Project generation (based on a 2008 City of Everett water demand of 84 million gallons per day (mgd) and using 109 years of hydrologic data) is 421,834 megawatt hours (MWh), providing approximately 5 percent of the District's current power requirements – enough energy to meet the needs of approximately 35,000 homes. Continued operation of the Jackson Project will reduce the District's reliance on power purchased from other generating resources, offering customers the opportunity to subscribe to a clean, renewable electrical source.

Project power is projected to decrease with time as the City of Everett's water demand increases. Current projections of power output at the end of a 30-year window of economic analysis for the next license is 394,936 MWhs. Therefore, the average power from Jackson under current operating conditions is expected to be 406,600 MWhs. The average annual cost of power for the 30 year analysis period is $14,772,097 in 2011 dollars (please see Exhibit H.3.1). If the Jackson Project was not available to the District for power production, the average annual cost of replacement power over the next 30 years under the current license conditions would be an estimated to be $18,752,816 (please see Exhibit H.2.2).

E.3 PROPOSED ACTION AND ALTERNATIVES

E.3.1 Proposed Action

The District proposes to continue operating the Jackson Project fundamentally the same as it has since 1984, meeting key objectives associated with the City of Everett's water supply; providing reliable electric power to the District's customers; and protecting and enhancing aquatic, terrestrial and recreation resources. For the next license term, the District proposes several facility and operational changes that are analyzed in this FLA.

Measures that would entail new construction include installing a new needle valve and governor controls to allow sustained flow deflection to bypass the two Pelton turbines during load rejection events; enhancing fish access to Sultan River side channels through excavation or other means, and removing barriers to fish passage in several tributaries to Spada Lake. The District also would install up to eight large woody debris (LWD) structures in the Sultan River to improve main channel habitat complexity.

In addition, the District will submit a request to amend the current license to contruct a new flow discharge structure on lands located within the Project boundary, adjacent to the City's Diversion Dam. The discharge structure would be spliced into the existing Diversion Dam pipeline, and would include a control system specifically designed to ensure the District's ability to release minimum instream flows and migration flows that may be recommended by the Aquatic Resource Committee.

The operational modifications would allocate specified volumes of water ("water budgets") from Spada Lake for release in the Sultan River to benefit aquatic and recreation resources. These include modifying the minimum instream flow requirements below the Diversion Dam and Powerhouse, modifying the downramping rate schedule at the Powerhouse to include downramping frequency, adding a downramping rate schedule to the new flow discharge structure, releasing 22,000 acre-feet of water over the 50-year license term to maintain the Sultan River channel (process flows); releasing 900 acre-feet over a 3-year trial period to test whitewater boating opportunities and interest; managing flows from the Project Powerhouse to benefit outmigrating juvenile salmonids and adult salmonids migrating upstream; and modifying the Spada Lake rule curve to balance the water demands for the municipal water supply and physical processes within the watershed, including flood control on the Sultan River. One other modification would include altering the upper instream flow limits in the fall to protect salmon redds from dewatering before fry emergence.

The District proposes to implement a Recreation Resource Management Plan that includes allowing non-motorized access across Culmback Dam and constructing a boater-access trail down its face, developing a new picnic and parking area in the vicinity of Culmback Dam, upgrading two boat launches on Spada Lake, converting some area roads to trails, increasing site maintenance, and a host of other measures.

The District would implement three plans to protect terrestrial resources, including a Noxious Weed Management Plan, a Terrestrial Resource Management Plan, and a Marbled Murrelet Habitat Protection Plan. To protect cultural resources, the District would implement an Historic Properties Management Plan.

E.3.1.1 Project Facilities

The following section describes existing Project facilities and two new proposed Project features. Additional Project schematics and photographs can be found in Exhibit A.

E.3.1.1.1 Spada Lake Reservoir

Table E.3-1-1 presents morphometric data for the Project reservoir, Spada Lake. The reservoir has a gross area of 1,908 acres at elevation 1,450 feet above mean sea level (msl) with a gross storage capacity of 153,260 acre-feet. While the maximum operating pool is at elevation 1,450 feet msl, the normal maximum surface elevation is 1,445 feet.

At this elevation, which typically occurs from June through mid-July, the normal maximum surface area is 1,802 acres, with a storage capacity of 143,982 acre-feet. Starting in late July, the pool is lowered to elevation 1,415 feet msl by mid-September to avoid spill later in the fall. This measure provides approximately 58,500 acre-feet of incidental flood storage prior to the onset of the October to December wet season. There is no minimum normal operating pool elevation for the Project because operations vary depending on the winter hydrologic conditions. To avoid vortex stresses in the power tunnel, diversion of water into the power tunnel ceases if the pool elevation drops to 1,380 feet msl or lower.

Table E.3.1-1 Morphometric and operational data for Spada Lake.

Drainage area (square miles)		69.21
Drainage area: surface area		23.7 : 1
Average annual discharge (acre-feet)		526,338
Surface elevation (feet msl)		
	Full pool	1,450
	Normal maximum surface elevation	1,445
	Average annual drawdown	1,420
	Maximum drawdown on record (January 20, 1993)	1,395.5
Surface area		
	Full pool (acres)	1,908
	Normal maximum surface area	1,802
	Average days/year at full pool	6.1
	Average days/year > 1445.0 feet	32.8
	Average annual drawdown (acres)	1,500
	Minimum operational pool (acres)	1,380
Volume (acre-feet)		
	Full pool	153,260
	Normal maximum volume	143,982
	Average annual drawdown	102,204
	Minimum operational pool	52,046
Maximum length (miles)		
	Reservoir centerline	5.00
	Old riverbed thalweg	5.25
Shoreline length (miles)		
	Full pool	21.98
	Average annual drawdown	16.90
Depth (feet)		
	Maximum (full pool)	210
	Mean (full pool)	180
Storage ratio (volume/average inflow)		0.29 : 1
Lake filling time (volume/inflow; years)		0.474
Lake flushing time (volume/outflow; years)		0.287

Source: Pfeifer et al. 1998 and District.

The Project uses all inflow to Spada Lake to generate power except for required minimum instream flow releases (to protect and enhance fisheries) and any spill at Culmback Dam. Water required to meet the City's municipal supply demands and to supplement instream flows for fisheries below the Diversion Dam generates power through two Francis turbine units installed at the Powerhouse, using the 700 feet of elevation difference (head) between Spada Lake and Lake Chaplain. Water in excess of the above requirements generates power through two Pelton units discharging directly into the Sultan River, utilizing the 1,000 feet of head between Spada Lake and the Powerhouse.

E.3.1.1.2 Culmback Dam

Culmback Dam is an earth and rock-filled dam, located at river mile (RM) 16.5 on the Sultan River, with a crest elevation of 1,470 feet msl. The crest of the dam is 25 feet wide, 640 feet long, and is 262 feet above the original streambed.

A concrete morning glory spillway is located within the reservoir approximately 250 feet from the right bank. This spillway has a 94-foot-diameter ogee crest, a 38-foot diameter vertical shaft and a 700-foot horizontal tunnel section. The morning glory spillway crest elevation is at 1,450 feet msl and is designed to pass the probable maximum flood of 57,790 cubic feet per second (cfs) at elevation 1,464.6 feet msl, or 5.4 feet below the crest of the dam.

Reservoir outlet works consist of two 48-inch-diameter conduits embedded in the concrete plug of the diversion tunnel that join the horizontal tunnel section of the spillway. The downstream ends of the conduits are equipped with three slide gate valves (two 42-inch and one 48-inch) and one 48-inch Howell Bunger valve. A 16-inch diameter pipeline runs through the right side of the dam at elevation 1,408 feet, then along its downstream face. This pipeline provides 20 cfs minimum flow releases when the spillway tunnel is dewatered for maintenance or safety inspections. Normal flow releases are accomplished through a 10-inch cone valve piped upstream of the 48-inch Howell Bunger valve that directs flow into the spillway tunnel.

A view of the Project hydraulic profile is presented in Figure E.3.1-1. A 60 kilowatt (kW) turbine generator in the dam outlet works provides onsite electrical power and contributes about 5 cfs to the reach below Culmback Dam. The total flow released by the 10-inch cone valve and the 60 kW turbine generator is 20 cfs.

The Powerhouse intake structure is located near the left abutment, approximately 250 feet upstream of the dam. The 110-foot-tall concrete structure has three 20-foot moveable panels. Positioning of these panels allows the selective withdrawal of stored water from various depths to facilitate the control of water temperature in the Sultan River below the Powerhouse and the Diversion Dam. A single 9-foot-wide by 14.3-foot-high fixed-wheel gate allows for closure and maintenance of the power tunnel. The gate is operated by a hydraulic cylinder on the access bridge. Hydraulic pressure for the gate operation is provided by a motorized hydraulic power unit located in an enclosure adjacent to the gate hoist.

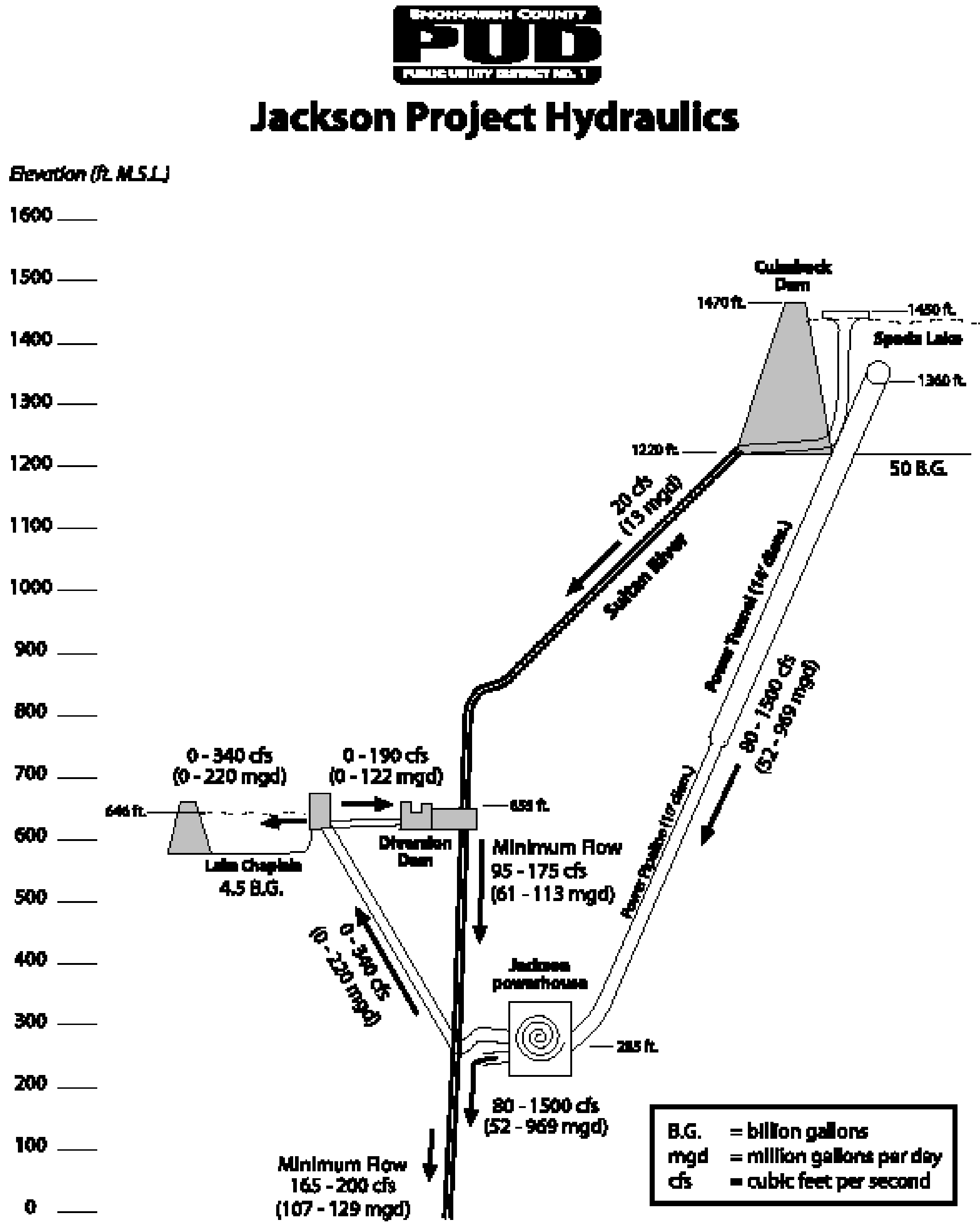


Figure E.3.1-1 Jackson Project hydraulic view.

E.3.1.1.3 Power Conduit

An unlined power tunnel, 14 feet in diameter, extends 3.8 miles from the intake structure through Blue Mountain. The tunnel has 3,140 feet of shotcrete-covered steel reinforcing to protect various soft rock areas. At the end of the power tunnel is a 150-foot-long rock trap to capture materials that fall into the tunnel. This collector prevents debris from entering the 10-foot-diameter welded steel power pipeline that transports water for 3.7 miles to the Powerhouse located on the lower Sultan River.

E.3.1.1.4 Power Plant

A semi-outdoor-type Powerhouse is located adjacent to the left river bank at RM 4.3. The structure is reinforced concrete with the top deck at elevation 316 feet, approximately 30 feet above peak river level for a 100-year flood. Two Pelton turbines and two Francis turbines are housed inside on the lower generator floor of the two-story 200-foot by 71-foot structure. The two Pelton turbines discharge directly into 40-foot-long discharge canals that transport water to the main river channel. The Pelton turbine runners are located 16.25 feet above the floor of the canal. The actual distance between the water surface and the Pelton turbine runners is dependent on discharge and tailrace elevation. During an average water year at average flow the turbine runner would be approximately 11.5 feet above the water surface. See Exhibit F for the physical characteristics of the Powerhouse and the tailrace. Because these are Pelton units the tailwater does not exert a back pressure. The Francis turbines re-route a portion of flow under the river via a pipeline (the Lake Chaplain pipeline) to the City's municipal water supply storage, Lake Chaplain, and to the Diversion Dam to supplement and meet minimum instream flows between the City's Diversion Dam and the Project's Powerhouse.

To alleviate any concerns that at certain flows power generation might cause confusion of adult fish migrating upstream past the Powerhouse, the District constructed and maintains a low-head fish passage berm at the upstream end of the Powerhouse. This berm has a passageway or slot near the Powerhouse to concentrate the river flows into an area that is more attractive to and can be more easily detected by migrating fish. The berm has successfully facilitated fish passage upstream of the Powerhouse since its construction in 1983.

E.3.1.1.5 Lake Chaplain Pipeline

The City's water supply requirements are mainly met by diverting water from Spada Lake through the Powerhouse's two Francis units. Sufficient pressure is retained, because of the 700-foot elevation difference between Spada Lake and Lake Chaplain and the Diversion Dam, to route the water from the Powerhouse through a 72-inch-diameter buried pipeline to the Portal 2 structure located on the shore of Lake Chaplain. The first 500 feet of the pipeline is welded steel construction and the remaining 17,886 feet is reinforced concrete cylinder pipe. The two Francis units are sized at 170 cfs each to provide water delivery to Lake Chaplain and the minimum instream flow requirements below the Diversion Dam at RM 9.7.

E.3.1.1.6 Portal 2 Structure

Under the current license the amount of water sufficient to maintain minimum instream flows below the Diversion Dam is returned to the Sultan River via a control structure located at the terminus of the Lake Chaplain pipeline. From the control structure the water is forced backward through the pre-existing diversion tunnel to the Diversion Dam. The control structure is called “Portal 2” because it was built on the lower end of the City’s diversion tunnel that originally transported water to Lake Chaplain from the Sultan River Diversion Dam. Within the base of the Portal 2 control structure water flowing into Lake Chaplain is constricted by a 5-foot-square slide gate. The restricted gate opening causes water to build up inside the tower, which then creates enough head to cause the water to back-flow to the Diversion Dam. By adjusting the Portal 2 gate opening, the required amount of water to be diverted to both Lake Chaplain and to the Diversion Dam can be accurately controlled.

E.3.1.1.7 Diversion Dam Tunnel and Pipeline

The diversion tunnel connecting Lake Chaplain to the Sultan River is a 1.5-mile-long horseshoe-shaped and concrete lined conveyance. A 72-inch, 2,000-foot-long concrete cylinder pipeline connects the upstream tunnel portal to the Diversion Dam where, under current Project operating conditions, flows are discharged back into the Sultan River to meet the Project instream flow requirements in the reach between the Diversion Dam and the Powerhouse. Maximum flow return capacity of the existing facilities is 189 cfs.

E.3.1.1.8 Sultan River Diversion Dam

The Sultan River Diversion Dam has been in place since 1930. It was originally used to divert water from the Sultan River into Lake Chaplain for the City of Everett’s water supply. It is a concrete ogee crest gravity structure 25 feet high and 120 feet wide. The Diversion Dam creates only a small headpond measuring a few acres in size. Water from Portal 2 flows into the forebay and is accurately measured through a weir in the main sluice gate. All flow below 280 cfs is routed through this weir. Higher flows are passed over the 120-foot-wide concrete spillway.

When the power conduit or the Lake Chaplain pipeline is not operational, the City’s water requirements can also be met by supplementing Lake Chaplain storage with water diverted from the Sultan River via the Diversion Dam and diversion tunnel to Lake Chaplain (see Section E.3.1.1.7 above).

The District intends to amend the current license to construct a separate instream flow discharge structure in line with the return pipeline to the Diversion Dam. The proposed structure will be located adjacent to the City’s Diversion Dam and approximately 800 feet upstream of USGS Gaging Station No. 12137800 below the Diversion Dam. The proposed discharge structure will allow the District to have a new facility for the purposes of meeting the license requirements for minimum instream flows below the Diversion Dam. This new structure will be constructed using the latest technology and controls, providing the District with enhanced regulation over minimum flows below the Diversion Dam. The new structure will be designed to allow the City of Everett to withdraw water from the Sultan River for flow into Lake Chaplain when normal operations of the Jackson Project are suspended for maintenance or inspections.

The District is in the process of selecting a consultant to design the structure and prepare the plans, specifications and the construction schedule for the new instream flow discharge structure. These drawings will be included in the application to amend the Project license that will be submitted to FERC by the end of 2009. For additional description of this proposal and a schedule for completion, please see Exhibit C.

E.3.1.1.9 Mechanical, Electrical, and Computer Control Equipment

Turbines and Generators

The Jackson Project Powerhouse contains two 47.5 MW Pelton turbines (units 1 and 2) and two 8.4 MW Francis turbines (units 3 and 4). Minimum unit discharge for each Pelton unit is 80 cfs and for each Francis unit, 44 cfs. The generating units are each equipped with a solid state static excitation and voltage regulation system. The neutral of each generator is grounded through a single phase distribution transformer. The generators are protected against possible winding insulation damage due to lighting or switching surge voltages.

Pelton Units

Each Pelton unit is a vertical shaft six-nozzle impulse turbine rated at 65,000 horsepower (hp), 257 revolutions per minute (rpm), and 1,000 feet of head. Together, the Pelton units can discharge up to 1,438 cfs directly to the river when operating at full power. Each unit has its own digital governor that can regulate the six nozzles each independently of the deflector control. The digital governors operate the generator/turbine in two modes: (1) power generation mode when on-line and synchronized to the transmission lines and (2) water bypass mode to control river level down ramps following unit or system problems that require the unit to quickly cease power generation mode. Each unit also has its own turbine shutoff valve for shutdown or maintenance purposes. The tail water discharges into the Sultan River. A work platform is provided for inspection of the buckets, needles and deflectors inside the turbine pit. Bottom removal of the runner is by means of a handling car and gantry crane outside of the Powerhouse through a hatch in the tailrace.

Generator units 1 and 2 are directly coupled to the Pelton turbines and are of the vertical shaft umbrella type with a combination upper thrust and guide bearing and a lower guide bearing below the rotor. Each is rated at 52.8 megavolt amperes (MVA), or 47,500 kW, at a power factor of 0.9. Main leads are connected by 15 kV, 2,500 ampere, self-cooled isolated phase buses to the generator step-up transformers.

Francis Units

The two Francis units are identical horizontal shaft units rated at 11,500 hp each, 900 rpm, and 675 feet net head. Each unit has its own governor to regulate the wicket gates for load variation with guard valves at the inlet and discharge of the unit. During maintenance periods, water can be diverted through pressure reducing valves before delivery to Portal 2 on the shores of Lake Chaplain. The turbine is coupled to the horizontal generator through a 10 ton flywheel. These units discharge to the Lake Chaplain water supply pipeline which returns up to 390 cfs (the maximum capacity of the Francis units) to Portal 2 for diversion into Lake Chaplain and return to the Diversion Dam.

Generator units 3 and 4 (Francis units) are of the horizontal shaft type and each is rated at 9.34 MVA, or 8,400 kW, at a power factor of 0.9. Main leads area connected to their respective unit breakers by 15 kV armored cable. Connection between the unit breakers and the step-up transformer is by a common non-segregated phase bus. Unit 3 and 4 breakers are the metal-clad switchgear type; each rated 13.8 kV, 1,200 ampere, 500 MVA.

Transmission System

Power generated within the Jackson Hydroelectric Project is delivered to the District's existing transmission system at a switchyard located adjacent to the Powerhouse. The Project's primary transmission system terminates at the three separate oil-filled circuit breakers located within the switchyard; one circuit breaker associated with each Pelton unit and one serving both Francis units.

From the three switchyard circuit breakers, power is transmitted to the "Jackson Loop," comprised of two single-circuit 115-kilovolt (kV) transmission lines with ACSR 795 conductors on wood poles. The "south transmission line" extends approximately 3.79 miles east and south from the Powerhouse switchyard and follows existing roads for most of the distance into the community of Sultan, where it connects to the District's Sultan Substation. After leaving the Powerhouse switchyard, the "north transmission line," which has never met the standard of a primary transmission line, immediately crosses the Sultan River and connects to the District's Lake Chaplain Substation approximately 1 mile to the west of the Powerhouse. Together these segments of the Jackson Loop provide dual redundancy for protection of the generation facilities from line outages. Figure E.3.1.-2 illustrates the entire Jackson Loop. The Jackson Loop also carries power from the Bonneville Power Administration (BPA) depending upon area demand, and it may also carry power from neighboring systems via the Gold Bar substation in the event of a Project shutdown or a failure in certain other parts of the District's transmission or supply system.

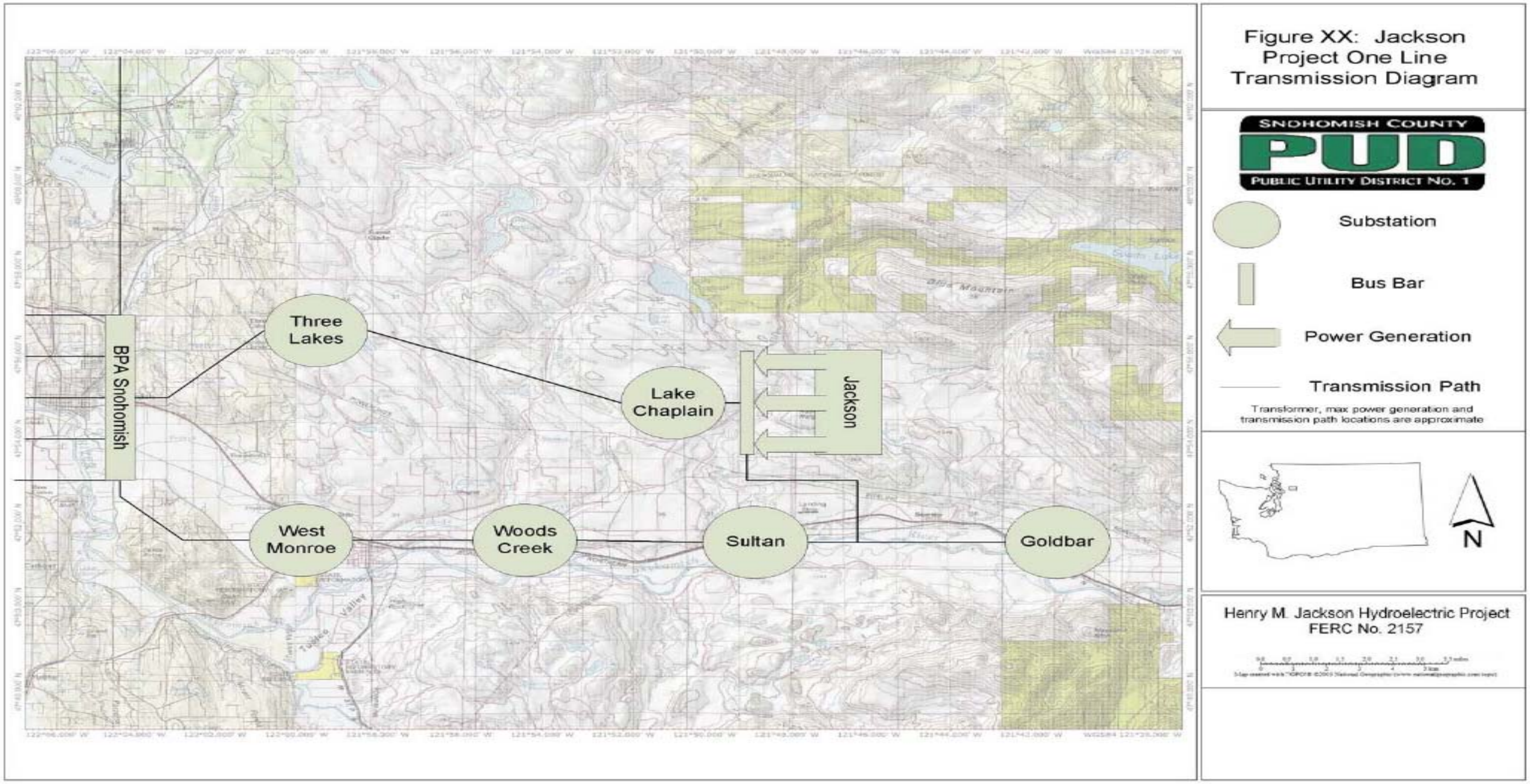


Figure E.3.1-2 Jackson loop transmission system.

The 3.9 mile segment of the Jackson Loop described as the "south transmission line" was originally a part of the Project and was included in the existing FERC Project boundary. However, as a result of improvements to the south transmission line, it now connects to several District substations prior to its interconnection with the BPA Snohomish Substation. Since this line no longer meets the criteria of a primary line for the Project[1], the District submitted an application to FERC on October 25, 2005, for a license amendment to remove the south transmission line from the Project. FERC amended the license on May 3, 2006, to remove the line from the Project facilities and from the Project boundary.

Computer Control System

The Project is monitored and controlled with a Supervisory Control and Data Acquisition (SCADA) system that allows monitoring and alarming of critical Project functions. The system is composed of several computers networked together. The main computer system is a set of dual redundant Digital Equipment Corporation processors with remote terminals to monitor and control functions at the Powerhouse, Culmback Dam, the Diversion Dam, Portal 2, and the electrical transmission and distribution system. The communication link between the master and remote stations is either by leased telephone line or microwave system.

A Main Plant Controller (MPC) consisting of redundant programmable logic controllers (PLCs) interfaces with the SCADA system and the plant control network. The main function of the MPC is to monitor the river level, to schedule Powerhouse generation, and in conjunction with the Pelton unit digital governors, to control the river level and down ramp rates.

An independent computer system at the Powerhouse uses Wonderware HMI (human-machine interface) software to monitor PLCs located at Portal 2, the Diversion Dam, Culmback Dam and the Powerhouse. At the Diversion Dam and Portal 2, these PLCs are programmed to respond to changes in Sultan River flows; thus, allowing the District to automatically meet the instream flow requirements below the Diversion Dam. At Culmback Dam the PLCs monitor and control the opening and closing of the 48-inch Howell Bunger valve and the 10-inch cone valve for accurate control of instream flows and downramping rates of Culmback Dam water releases into the Sultan River.

The computer control system is designed to allow the units to be operated manually or semi-automatically from the main control switchboard located in the Powerhouse control room. The main control switchboard consists of a lineup of panels containing unit controls, indication, metering, recording, alarm, unit and line protection relays.

[1] Section 3(11) of the Federal Power Act, as refined by FERC, defines primary transmission lines to be only those lines used solely to transmit power from the licensed project to the load center, and without which there would be no way to transmit the project power to market.

E.3.1.1.10 Other Appurtenant Equipment and Systems

Mechanical

Oil Storage and Handling System

An oil storage-oil transfer room for governor and bearing lubricating oil is located in the Powerhouse. Separate used oil and clean oil tanks are provided. Contaminated or dirty oil is transferred into a mobile tank outside of the Powerhouse for disposal. The switchyard has its own oil water separator for transformer/oil circuit breaker leakage.

Cooling Water System

Cooling water for the generator heat exchangers and bearings is taken from the turbine pits by means of vertical pumps and from the Lake Chaplain pipeline by means of a control valve. The heat exchangers also have control valves.

Compressed Air System

There is a dual set of air compressors for the purpose of generator air brakes, instrument air and service air. A low pressure isolation valve is provided where only the air brakes are served when the system pressure drops below a preset level.

Fire Prevention System

High pressure bottled CO_2 is provided for the generators and the oil storage room. A manual water fire suppression system is installed in each generator's housing. In addition, portable extinguishers, fire hose reels and hydrants are provided and strategically located inside and outside the Powerhouse. Fire water supply is taken from the turbine pit and Lake Chaplain pipeline.

Sanitary Disposal System

A large tank collects all sewage from the bathrooms and water washing stations. Periodically, a sewage disposal service removes the contents for proper disposal at a local sewage treatment facility.

Gantry Crane

A gantry crane with a main and auxiliary hoist for maintenance purposes was constructed on the top deck of the Powerhouse. The main and auxiliary hoists are rated for 150 and 25 tons respectively. The bridge is extended beyond the face of the Powerhouse for the purpose of runner removal and installation of bulkheads in the tailrace.

Heating, Ventilating, and Air Conditioning Systems

The Powerhouse is ventilated by means of air handling units, except the control room is air conditioned by a packaged unit. Duct heaters and unit heaters with thermostatic controls, and fire dampers are provided.

System Drain

There is a pressure reducing valve provided for draining the power conduit and the Lake Chaplain pipeline. For power conduit draining, the top portion is through the unit 3 or 4 pressure reducing valve. The residual water in the spiral case is then drained by means of a spiral case drain valve. For the Lake Chaplain pipeline, the Francis units are shut down and the pipeline drained to the Sultan River through the pressure reducing valve.

Power Generation at Culmback Dam

Site power for facilities at Culmback Dam is supplied by a reversed Cornell pump attached to a 60 kW generator located in the outlet chamber below the right abutment. Backup power is supplied by a 60 hp John Deere diesel engine driving a 60 kW Kato light generator located in the control building upstream of the left abutment of the dam.

Electrical

Station Service Unit Substation

Station auxiliary power is provided by unit substations fed from unit 2 generator terminal segregated phase buses and the unit 3/4 non-segregated phase bus. Each unit substation consists of a 13.8 kilovolt (kV) fused disconnect load interrupter, three single phase step-down transformers, and secondary main breaker. Project power (480/277 volt, 3 ø, 60 Hertz [Hz]) is distributed to strategically located load centers in the Powerhouse. An emergency source is supplied by a 480/277 volt 3 ø padmount transformer located at the southeast corner of the top deck. The padmount transformer is connected to a dedicated 12.47 kV 3 ø circuit from the Lake Chaplain Substation.

DC System

A 125-volt direct current (DC) system, consisting of a station battery, dual battery chargers, and DC distribution centers, provides an uninterrupted source for control, protection, and indication.

Grounding

An electrical equipment grounding system serves to protect equipment and provide safety to personnel by reducing touch potential and controlling the potential gradients along the surface of the facilities where high voltage lines and equipment are installed.

Lighting

The lighting system is supplied by 480/277 volt lighting panels suitably located in the Powerhouse. Generally, fluorescent and mercury vapor fixtures are used for normal lighting. Lighting fixture types are selected to suit the particular applications. Illumination levels are adequate for the required visual tasks.

Switchyard

The 115 kV switchyard is located on the east side of the Powerhouse at elevation 313 feet msl. The switchyard contains three-step-up transformers, five oil circuit breakers, disconnect switches, and bus potential transformers. Transformers and the two outgoing transmission lines each have an oil circuit breaker and isolating disconnect switches. All generation and the outgoing line terminate on a single bus. Switchyard structures accommodate the high voltage disconnect switches, insulators, and the bus. All buses in the switchyard are copper conductors.

Transformers

The main transformers are of the three-phase, two-winding, oil-immersed class OA/FA/FA type suitable for outdoor operation. Units 1 and 2 each have a step-up transformer, whereas units 3 and 4 are paralleled to a common step-up transformer.

Oil Circuit Breakers

Oil circuit breakers are rated 121 kV, 1,600 ampere, and 10,000 MVA interrupting.

Disconnect Switches

Disconnect switches are rated 121 kV, 1,600 ampere, 550 kV BIL, and 70,000 ampere momentary.

E.3.1.1.11 Proposed New Structures and Facilities

Pelton Unit Bypass

To protect the aquatic resources of the Sultan River below the Powerhouse from rapid dewatering when either of the Pelton units trips off line, the District proposes to remodel the governor and needle valve controls for each unit. These modifications will allow flow continuation through the Powerhouse into the Sultan River while either unit can be shut down as necessary. The current configuration is set up to deflect the Pelton nozzle flow away from the turbines and to close off the needles in a relatively short time. Governor control modifications and upgrades will allow independent controlled operation of the deflector blades and the needle closure. Because this is an important aquatic protective measure, the District has offered to make the expenditures to accomplish this goal by the end of 2009.

Sultan River Discharge Structure

To return water to the Sultan River using a new structure built with the latest technology and controls, the District is preparing an application to amend the current license to construct a concrete discharge structure in line with the 72-inch return line from Portal 2 of the City of Everett Lake Chaplain Tunnel to the Diversion Dam on the Sultan River. This structure would be located on District land adjacent to the City's Diversion Dam and upstream of USGS Gaging Station No. 12137800. The tailrace of the new structure would be constructed to ensure minimum flow releases are discharged at about the present location of the downstream apron of the Diversion Dam main sluice gate. Although not a component of the relicensing process, the effects of this new structure are analyzed in this document and it has been found to have no adverse effects associated with downstream resources. It would be constructed to allow either discharge of water into the Sultan River to meet instream flow requirements or diversion of water from the

Sultan River by the City of Everett's Diversion Dam to flow back to Lake Chaplain when normal flow pattern to Lake Chaplain from the Powerhouse is disrupted for long periods of time. See Exhibit C for a more detailed description of the shape and location of this proposed structure and a schedule for design and construction.

E.3.1.2 Project Operations and Resource Utilization

The following section provides information about Project operations and generation. Additional information about Project operation can be found in Appendix A, the Operations Plan and supplement.

E.3.1.2.1 Project Operations

Plant Supervision

The four generators at the Project Powerhouse can be operated on-site either manually or automatically. They may also be operated remotely from the District's operations center near Paine Field in south Everett or the main headquarters building in downtown Everett. The Powerhouse, operations center, and headquarters buildings are linked by a system of microwave communications. Information indicating the status of bearing temperature, cooling water flow, relay operation, and other critical functions are relayed to the Supervisory Control and Data Acquisition computers in Everett over the microwave links. In addition to controlling the generators, operators can raise or lower gates at Portal 2 on the east side of Lake Chaplain, or close the intake gate at Spada Lake. Although the primary operating control resides at the main headquarters building in Everett and the operations building in South Everett, District staff is on-site to provide oversight 8 hours per day, 5 days per week and remain on-call during the off-hours.

Estimated Annual Plant Factor

Operations of the Jackson Project are governed by an Operating Plan which has been modified several times since the power generation facilities were constructed in the early 1980s. The Jackson Project is not operated to provide flood storage or specific flood regulation; however, flood control is incidental to the operation of the Project to minimize flooding from the Sultan River into the Skykomish River at Sultan, Washington. The rule curves were modified in November of 1989 to allow a larger State 3 area (see Section E.3.1.2.2); therefore, generation averages calculated from 1990 onward reflect current operations. Based on gross energy generation records (see Exhibit B, Section B.2.2) and net plant capability under most favorable operating conditions as reported on the FERC Form 1, the average annual plant factor for water years 1990 through 2007 for the Jackson Project was 42 percent. Based on computer modeling of Project operations where the City of Everett water demands will increase over time, the average annual plant factor over the 30 years from 2011 to 2041 for both current and proposed operations is also expected to be 42 percent. For more explanation of Project operations, please see the Supplemental Paper to the Proposed Operating Plan located in Appendix A.

Operation during Low, Mean, and High Water Years

The operation of Spada Lake is in accordance with the reservoir rule curves (see Appendix A of this FLA and Exhibit B, Section B.2.4.2) to minimize spill and contribution to flood conditions on the lower Sultan River. The reservoir elevations are influenced by the inflows and volumes of water withdrawn for generation throughout the year.

For the 1990 to 2008 water years[2] the minimum and maximum water elevation for each day of the water year for this period is shown in Figure E.3.1-3. Examples of reservoir elevations during low, mean, and high water years are shown in Figures E.3.4 through E.3-6 respectively.

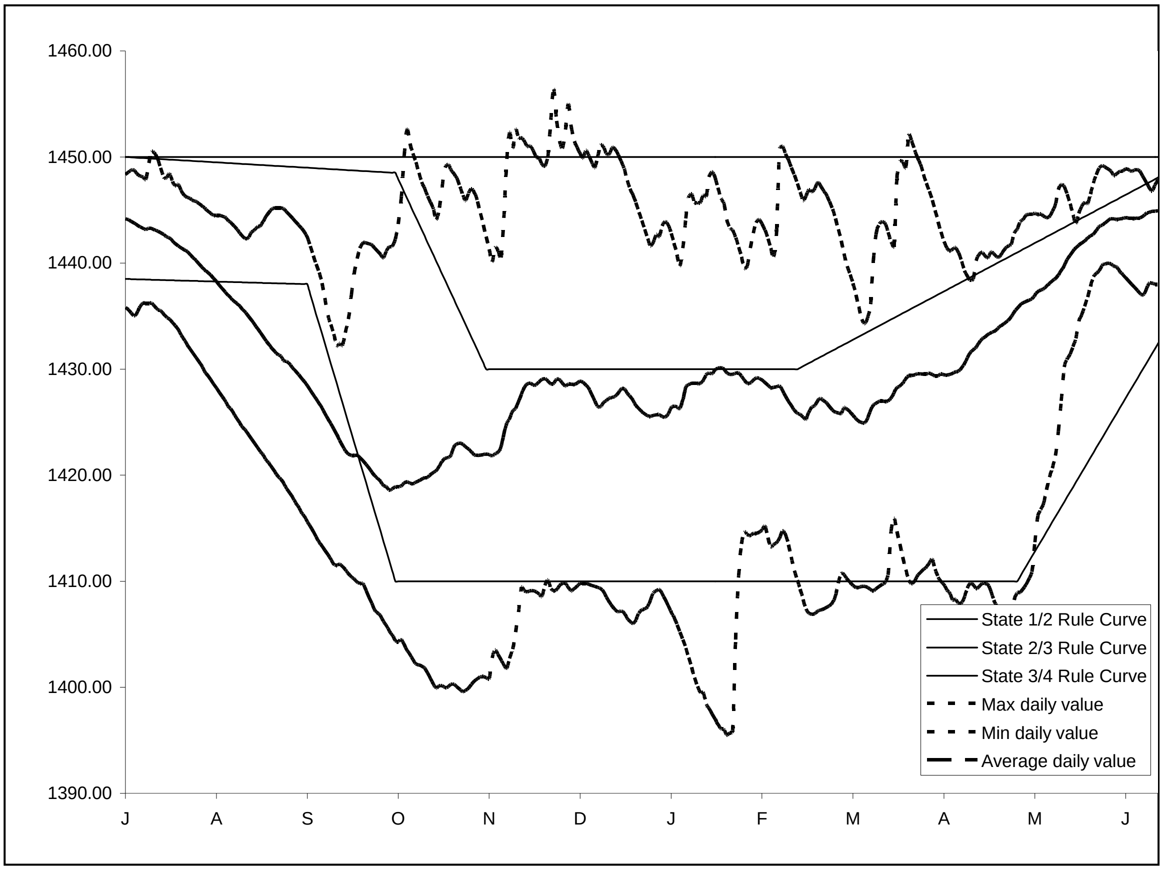


Figure E.3.1-3 Maximum and minimum daily elevations - July 1990 to June 2008.

[2] Jackson Project water years run from July 1 through June 30.

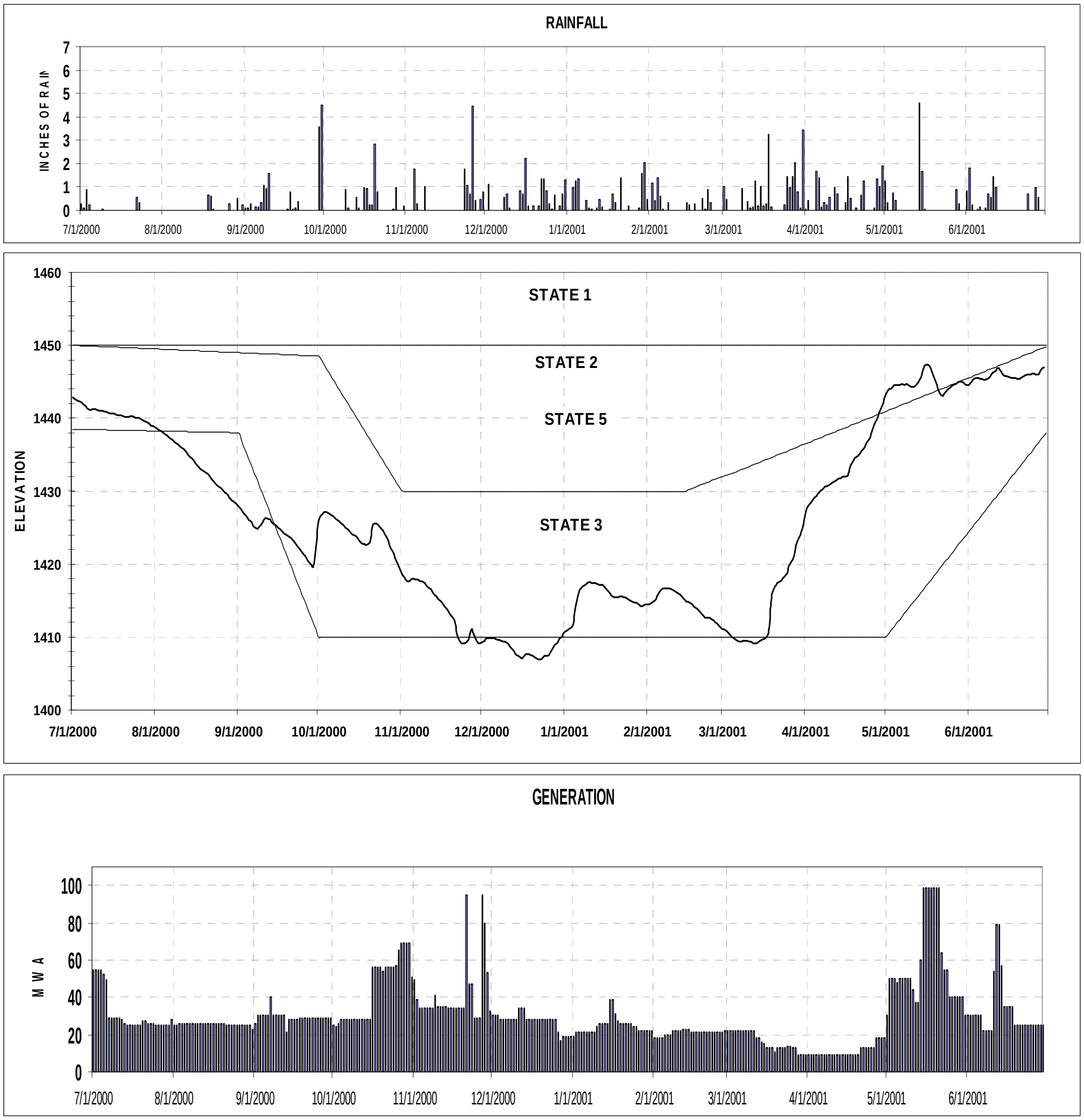


Figure E.3.1-4 **Dry water year reservoir operation (2001). Rainfall = 126 inches, Generation = 264,984 MWh.**

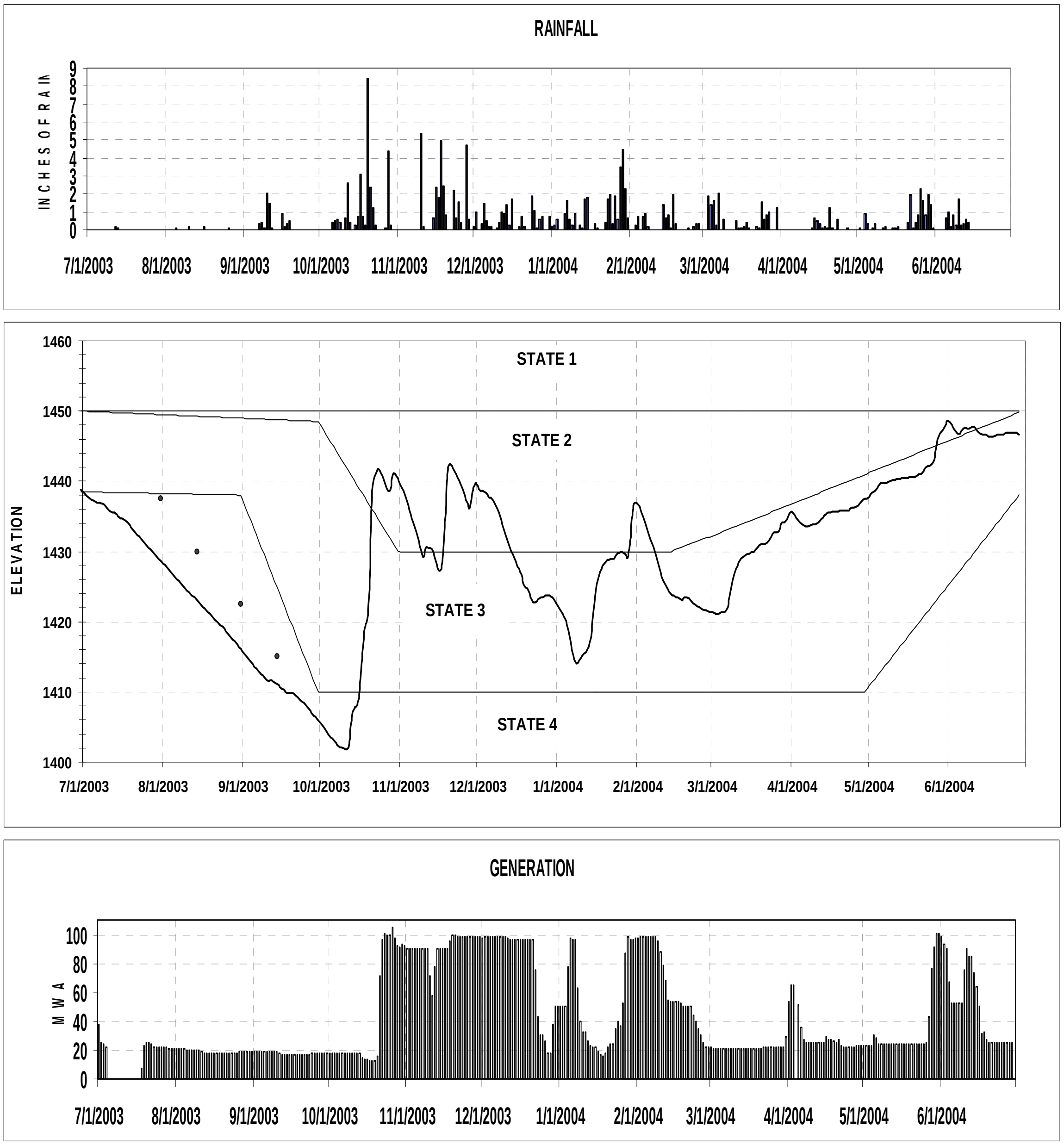


Figure E.3.1-5 **Mean water year reservoir operation (2004). Rainfall = 153.11 inches, Generation = 373,341 MWh.**

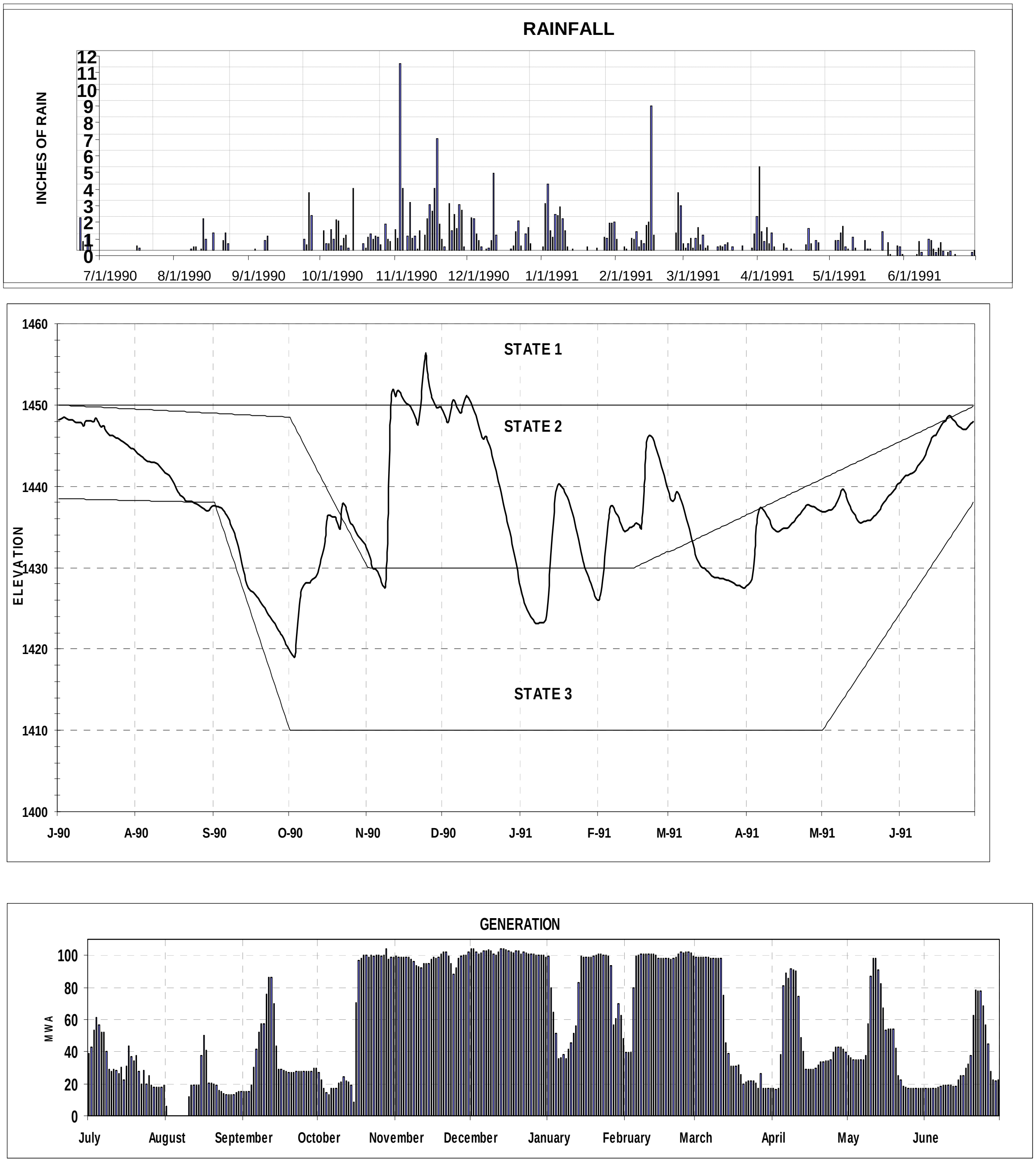


Figure E.3.1-6 **Wet water year reservoir operation (1991). Rainfall = 204 inches, Generation = 496,304 MWh.**

E.3.1.2.2 Project Capacity and Generation

Dependable Capacity

The dependable capacity is the average output that the Jackson Project can sustain to meet peak-hour load requirements during a critical streamflow period. The daily peak-hours are 6:00 a.m. to 10:00 a.m. and 5:00 p.m. to 9:00 p.m., except for Sunday, which is an off-peak day. The District coordinates operation of the Jackson Project with other generating plants operated by the parties to the Pacific Northwest Coordination Agreement (PNCA). The District has adopted the critical period used under the PNCA (October 1940 to September 1941) as the basis for the Jackson Project critical period used to determine dependable capacity.

Dependable capacity of the Jackson Project under current operating conditions (with City of Everett water demand at 84 mgd in 2008) is estimated to be 28.41 MW. By 2011 when the new license term will start, the current dependable capacity of the Jackson Project under current operating condition is estimated to be 27.76 MW because of the projected increase in the City of Everett water demand. See the Supplemental Paper to the Project Operating Plan in Appendix A for a more detailed explanation of the impacts of City water demands on Jackson Project power production.

The proposed Project operation includes a modified reservoir management regime and a new downstream release regime consisting of modified minimum flows. Dependable capacity with the proposed operating plan is estimated to be 27.60 MW in the year 2011, a decrease of 0.16 MW. The dependable capacity declines as the City Water demand increases. In approximately 2035, when the City of Everett water demand is expected to be 144 mgd, the dependable capacity under the current and proposed operations are 24.97 MW and 23.16 MW respectively. This decrease in dependable capacity will be a result of longer times in the power-off zone below 1,380 feet msl in Spada Lake (see the proposed Operating Plan in Appendix A).

Average Annual Generation

As discussed in Appendix A and in Exhibit B, Section B.1.2, the period of record best reflecting current conditions is from water year 1990 through 2008. A full range of flow conditions was encountered during this period, and long term generation during this period is reasonably representative of current conditions.[3]

Annual historical gross generation during the 18-year period from water years 1990 through 2008 averaged 408,970 MWh, and station service averaged 829.92 MWh.

As described in Exhibit C, the District has maintained and upgraded the Jackson Project since the amending of the FERC license to add the hydroelectric facilities in 1981. A computer model of Project operations was developed by Bechtel Corporation to simulate and estimate average annual energy production from the Jackson Project. District staff has continuously updated this model and have simulated operations under the current and

[3] The generation data are recorded on a July 1 to June 30 water year basis.

proposed operating plans. Tables E.3.1-2 through E.3.1-4 summarizes the modeled estimates of energy generation under the current and proposed operations under a new license. These estimates are based on the simulated hydrology for the Sultan Basin for the period 1900 through 2008. Please see the Supplemental Paper to the proposed Operations Plan in Appendix A of this Final License Application for further description of the Jackson Project simulation modeling.

Table E.3.1-2 Jackson Project dependable capacity and average annual energy estimates (City of Everett average annual water demand = 84 mgd).

Item	Current Operation	Proposed Operation
Dependable Capacity (MW)	27.76	27.60
Average annual energy (MWh)	421,834	427,155

Table E.3.1-3 Jackson Project dependable capacity and average annual energy estimates (City of Everett average annual water demand = 144 mgd).

Item	Current Operation	Proposed Operation
Dependable Capacity (MW)	24.97	23.16
Average annual energy (MWh)	398,940	398,261

Table E.3.1-4 Jackson Project dependable capacity and average annual energy estimates (City of Everett average annual water demand = 192 mgd).

Item	Current Operation	Proposed Operation
Dependable Capacity (MW)	19.54	15.48
Average annual energy (MWh)	370,910	370,231

Flow Data and Flow Duration Curves

Inflow to the Jackson Project reservoir is not measured directly, but rather calculated using a mass balance approach. Flow data are available from USGS Gaging Station No. 12137800 located 900 feet downstream of the Diversion Dam (RM 9.7) and from USGS Gaging Station No. 12138160 located just below the Powerhouse (RM 4.5).

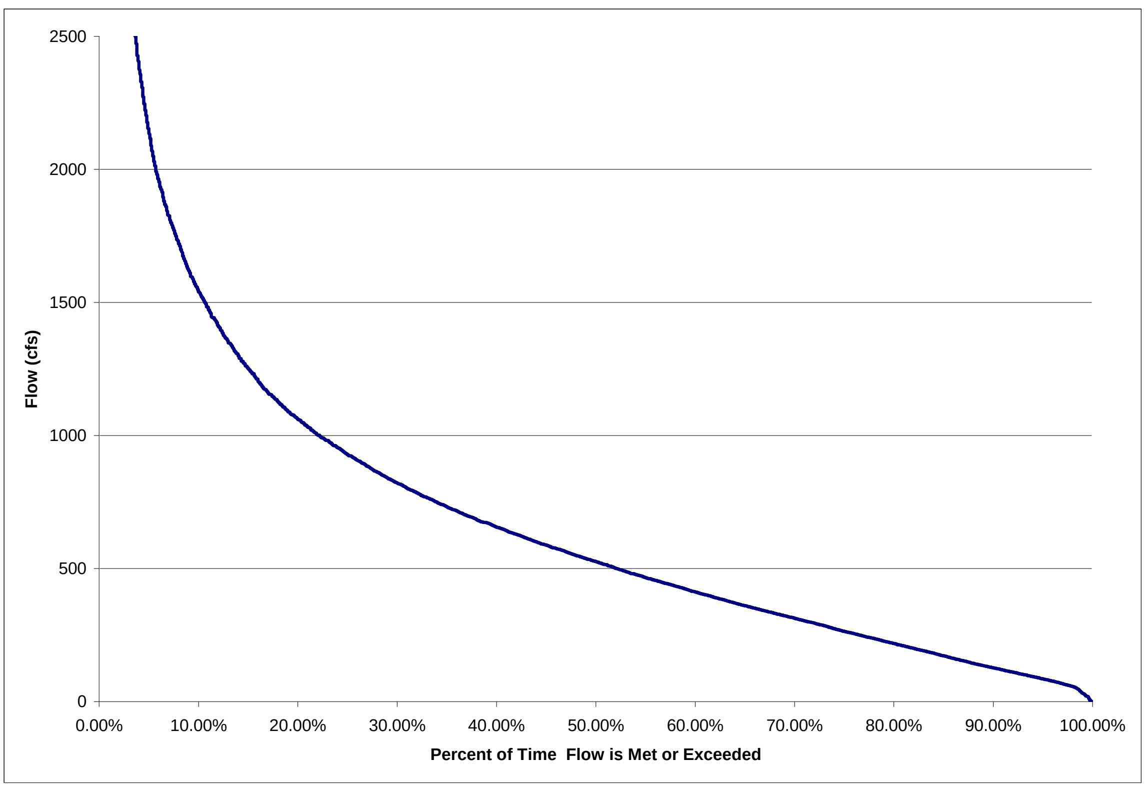
Additionally, the District maintains records of reservoir elevations, generation at the Powerhouse, and outflows from Culmback Dam. Combining this information with knowledge of drainage areas and local hydrology allows staff to produce reasonable estimates of Project inflows.

Flow statistics for water years 1990 through 2008, reflecting the period of current Project operation, are summarized in Table E.3.1-5. The average inflow to Spada Lake is consistent with longer term inflow records. For example, the average flow for water years 1929 through 2008 is 768.5 cfs.

Table E.3.1-5 Flow statistics for water years 1990 through 2008.

Statistic	Flow (cfs)
Daily average flow	731.4
Minimum daily flow	21
Maximum daily flow	19,670

The annual flow duration curve for the Jackson Project inflows for the period of record of water years 1935 through 2008 is shown in Figure E.3.1-7. For clarity, the curve is truncated at 2,500 cfs. As shown above, the actual maximum is 19,670 cfs, but 2,500 cfs represents the 96.3 percent exceedence flow. Monthly flow duration curves for the same period (1935 – 2008 water years) are provided in Exhibit B, Appendix B-1.



(Source: Snohomish PUD)

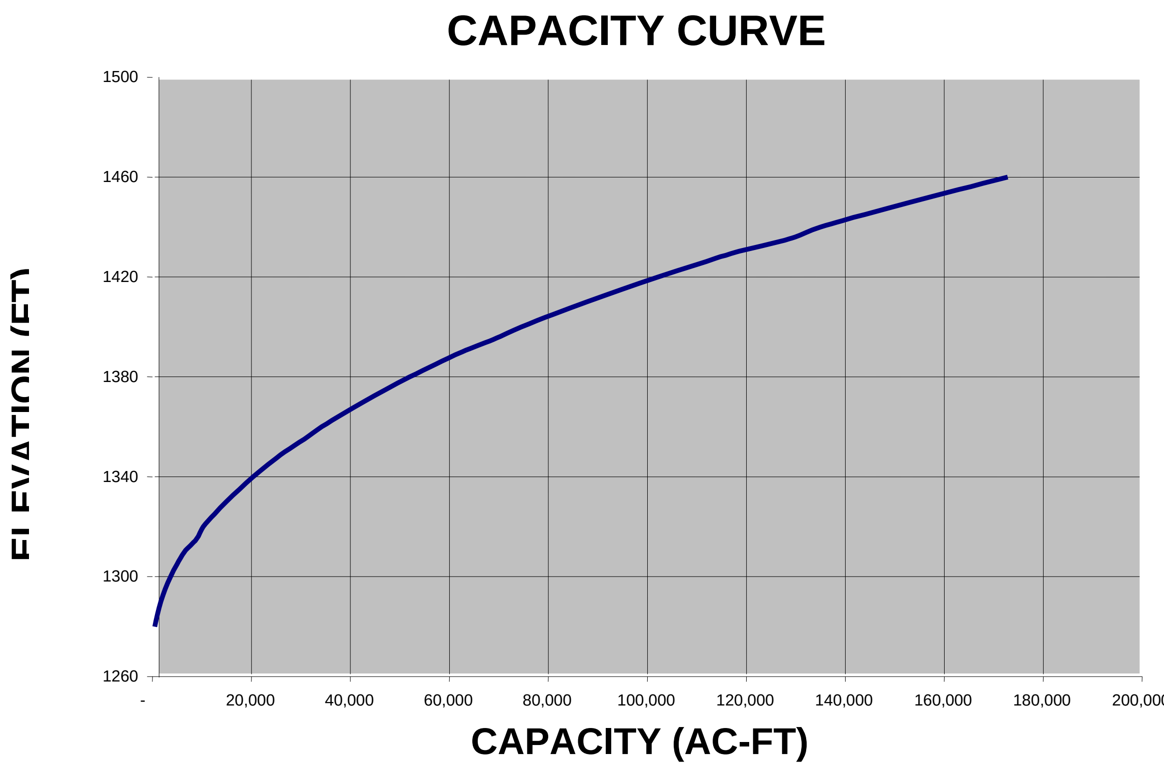
Figure E.3.1-7 Flow duration curve for unregulated daily average inflows to Spada Lake (water years 1935 to 2008).

The period of critical stream flow used to determine dependable capacity is October 1, 1940 to September 30, 1941. During this period the average daily inflow to Spada Lake was 515.3 cfs.

Reservoir Operation Curves

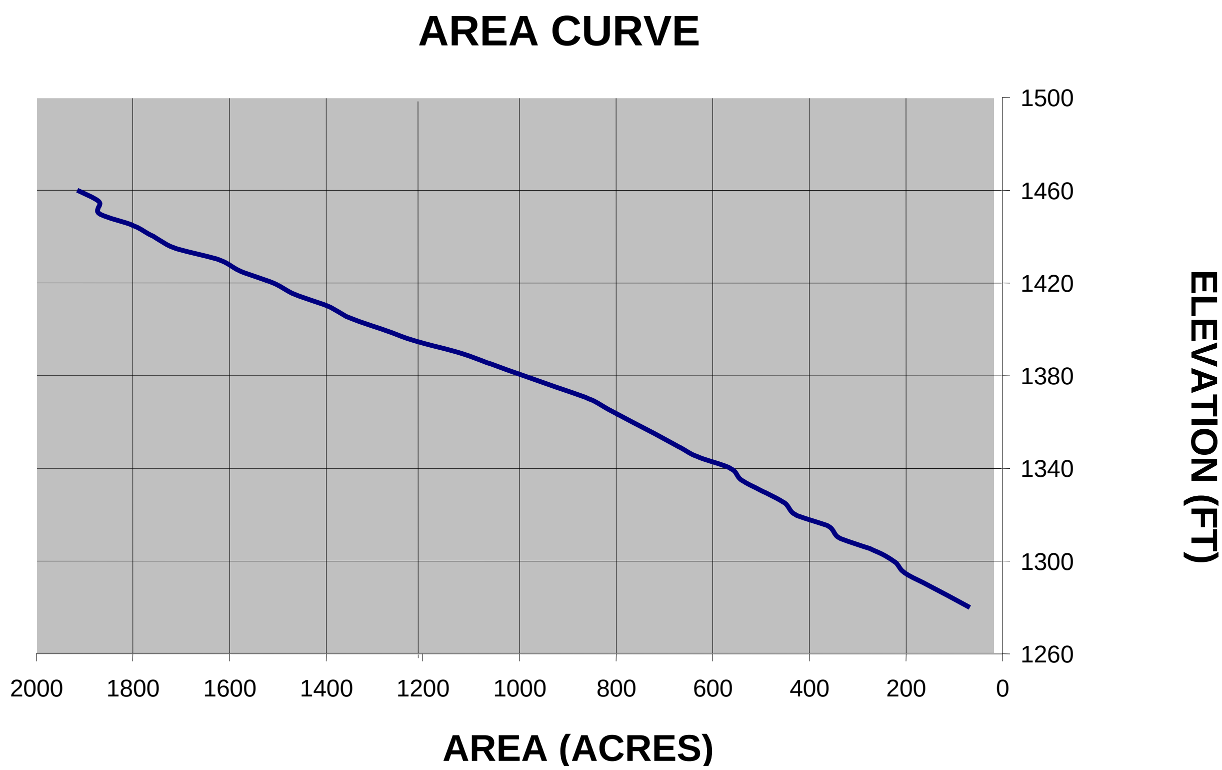
Area-Capacity Curves

Surface area and capacity of Spada Lake as a function of elevation are shown in Figures E.3.1-8 and E.3.1-9. Gross storage for Spada Lake Reservoir is 153,260 acre-feet. Useable storage for power generation is 101,218 acre-feet from the maximum height of the spillway at 1,450 feet msl to 1,380 feet msl, the level power operations would cease to avoid inducing coriolis forces in the power tunnel.



(Source: Snohomish, 1980)

Figure E.3.1-8 Elevation vs. storage curve for Spada Lake.



(Source: Snohomish, 1980)

Figure E.3.1-9 Elevation vs. area curve for Spada Lake.

Reservoir Rule Curves

Current Rule Curves

The Spada Lake rule curves currently governing Project operation are shown in Figure E.3.1-10. These rule curves allow the District to provide a balance of reliable municipal water supply to the City of Everett, instream flows for fisheries resources, incidental winter flood storage, and higher lake levels for early summer recreation. Developed based on the physical storage capacity of Spada Lake and the hydrology of the Sultan Basin, the rule curves divide Spada Lake into States that shift throughout the July through June water year, which is used to minimize the change in storage from year to year.

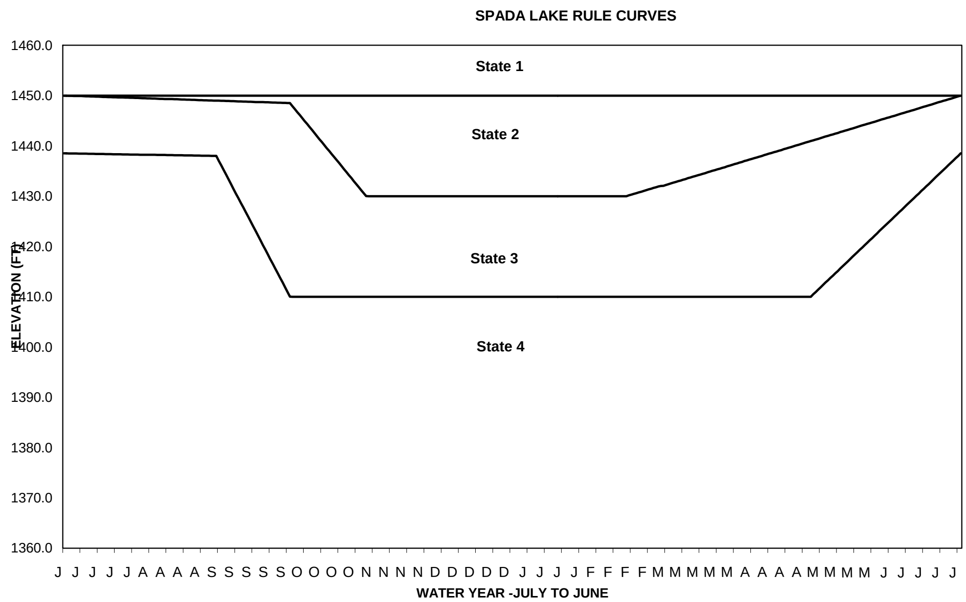


Figure E.3.1-10 Current Spada Lake operational rule curves.

State 1 – Zone of Spill. Above elevation 1,450 feet msl, Spada Lake is in a state of spill. Therefore, the District operates the Powerhouse to withdraw at least 1,300 cfs through the power tunnel.

State 2 – Zone of Potential Spill. The District operates the Powerhouse to withdraw at least 1,300 cfs through the power tunnel.

State 3 – Zone of Discretionary Operation. The District may operate the Powerhouse between the extremes of State 2 and State 4 depending on maintenance, power supply, and prudent operation to minimize the impacts to the fishery resources.

State 4 – Zone of Water Conservation. The District operates the Powerhouse to satisfy the requirements of its water supply obligations to the City of Everett and the instream flow requirements in the Sultan River.

Proposed Rule Curves

The only alterations of the Project rule curves proposed for the next license term is a minor modification to the State 3-4 line between July 1 and October 1, the clarification of operations in state 2 and 4 to allow inflow forecasting to enhance prudent decision making, and the designation of State 5 as described below (Figure E.3.1-11).

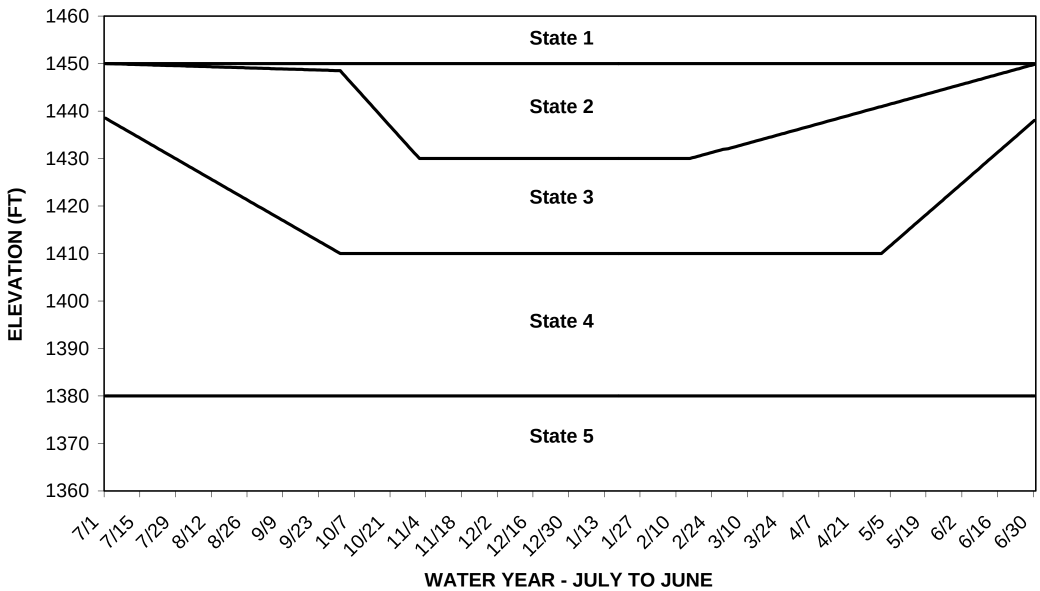


Figure E.3.1-11 Proposed Spada Lake operational rule curves.

<ins>State 1 – Zone of Spill</ins>. Above elevation 1,450 feet msl, Spada Lake will be in a state of spill. Therefore, the District will operate the Powerhouse to withdraw at least 1,300 cfs through the power tunnel.

<ins>State 2 – Zone of Potential Spill</ins>. The District will operate the Powerhouse to withdraw at least 1,300 cfs through the power tunnel unless inflow forecasts show that there is minimal risk of spill.

<ins>State 3 – Zone of Discretionary Operation</ins>. The District may operate the Powerhouse between the extremes of State 2 and State 4 depending on maintenance, power supply, and prudent operation to minimize the impacts to the fishery resources.

<ins>State 4 – Zone of Water Conservation</ins>. The District will operate the Powerhouse to satisfy the requirements of its water supply obligations to the City of Everett and the instream flow requirements in the Sultan River. Generally, the Project is operated to conserve water unless inflow forecasts and snowpack measurements indicate higher rates of water withdrawal through power production are warranted.

<ins>State 5 – Zone of Tunnel Protection.</ins> Below elevation 1,380 feet msl the District ceases to operate by water withdrawal through the Powerhouse at flows which would result in vortex creation in the power tunnel. Vortexes could cause power tunnel collapse from the negative hydraulic pressures of spiral flow. The District would release supplemental water from the outlet valves at the base of Culmback Dam to satisfy instream flow and water supply requirements. The Culmback Dam outlet valves are at elevation 1,220 feet msl.

Hydraulic Capacity

The minimum plant hydraulic capacity at the Jackson Powerhouse is 70 cfs. The maximum plant hydraulic capacity at the Jackson Powerhouse is 1,300 cfs.

Tailwater Rating Curve

Because the turbines that discharge into the Sultan River below the Powerhouse are Pelton units, a tailwater rating curve is not applicable.

Power Plant Capacity vs. Head Curve

Figure E.3.1-12 illustrates the relationship between the output capacity of both the Jackson Project Pelton units and the net head. Each Pelton unit is rated at a capacity of 47.5 MW and limited by protective relays at 55 MW each. The maximum normal head occurs when the headwater is at the normal full pool level of 1,450 feet msl. This results in a gross head of 1,165 feet, which when adjusted for head loss results in a net head of 928 feet at 100 MW of generation (both Peltons combined). Under the median pool level of 1,430 feet msl, the corresponding gross head would be 1,145 feet and the net head would be 908 feet if producing 100 MW of generation. Similar computations at the minimum generating pool of 1,380 feet msl yield a gross head of 1,095 feet. The curve illustrates that as the generation of the Powerhouse increases the net head decreases because of friction losses in the power tunnel.

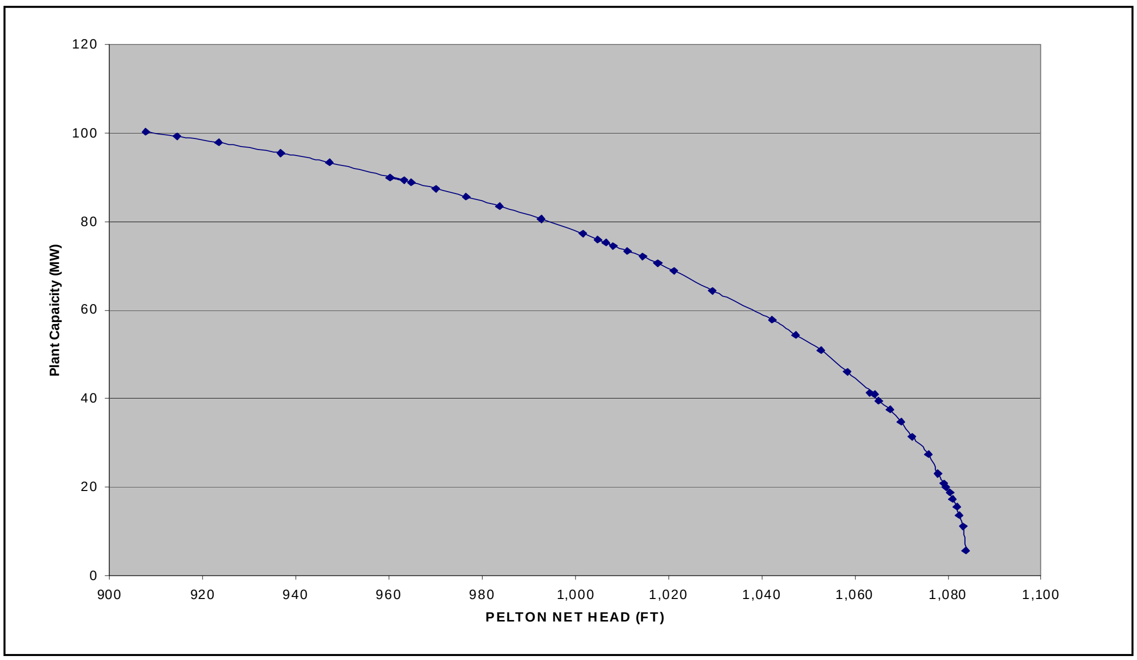


Figure E.3.1-12 Jackson Powerhouse capacity vs. head curve (Spada Lake 1,430 ft msl).

Figure E.3.1-13 illustrates the relationship between the output capacity of the Jackson Project Francis units and the net head. The capacity of the Francis units is rated at 8.4

MW with relay protection limits of 10.5 MW. The maximum normal head occurs when the headwater is at the normal full pool level of 1,450 feet msl. This results in a gross head of 780 feet, which when adjusted for head loss results in a net head of 685 feet at 8.4 MW of generation. Under the median pool level of 1,430 feet msl, the corresponding gross head would be 760 feet and the net head would be 685 feet if producing 8.4 MW of generation. Similar computations at the minimum generating pool of 1,380 feet msl yield a gross head of 710 feet. Actual net head is determined by the actual lake level and the operating status of the other three units, which in turn affect the power conduit flow and resulting head loss.

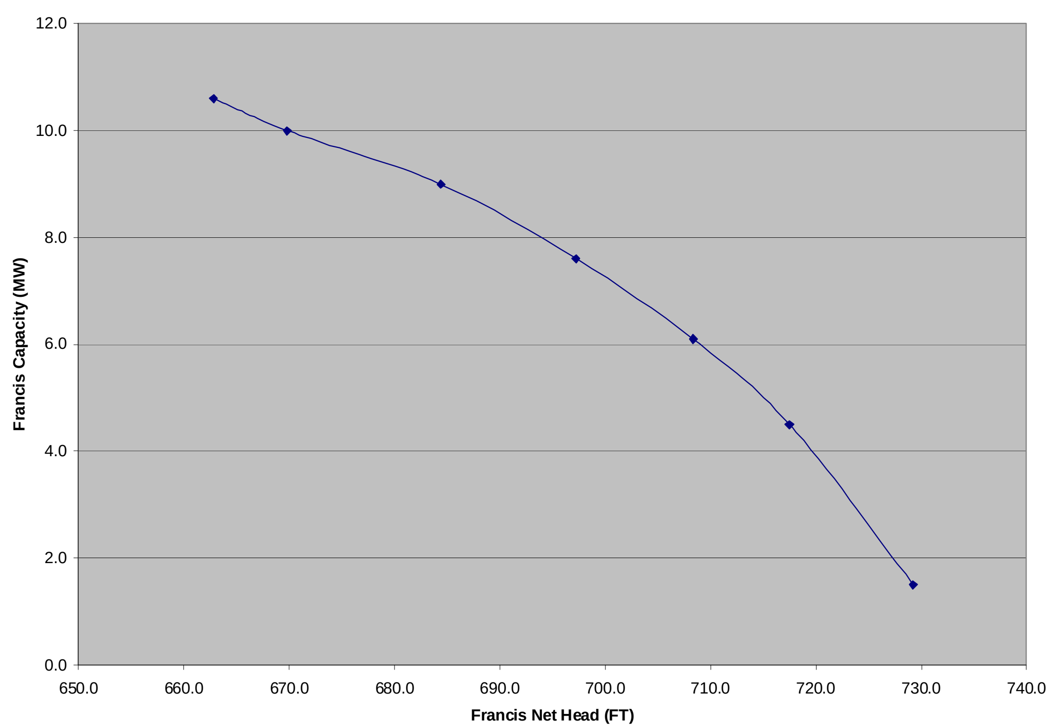


Figure E.3.1-13 Jackson Project Francis unit capacity vs. head curve.

E.3.1.2.3 Project Output Utilization

The District uses the output of the Jackson Project to meet system load. A portion of the Project output is used to meet station service requirements as described in Section E.3.1.2.2. The system load for the District varies from 468 average megawatts (MWa) to 1,560 MWa depending on time of day and season of use. Figure E.3.1-14 illustrates the District's monthly load curve. On average, the Jackson Project annually produces approximately 5 percent of the District's power supply needs.

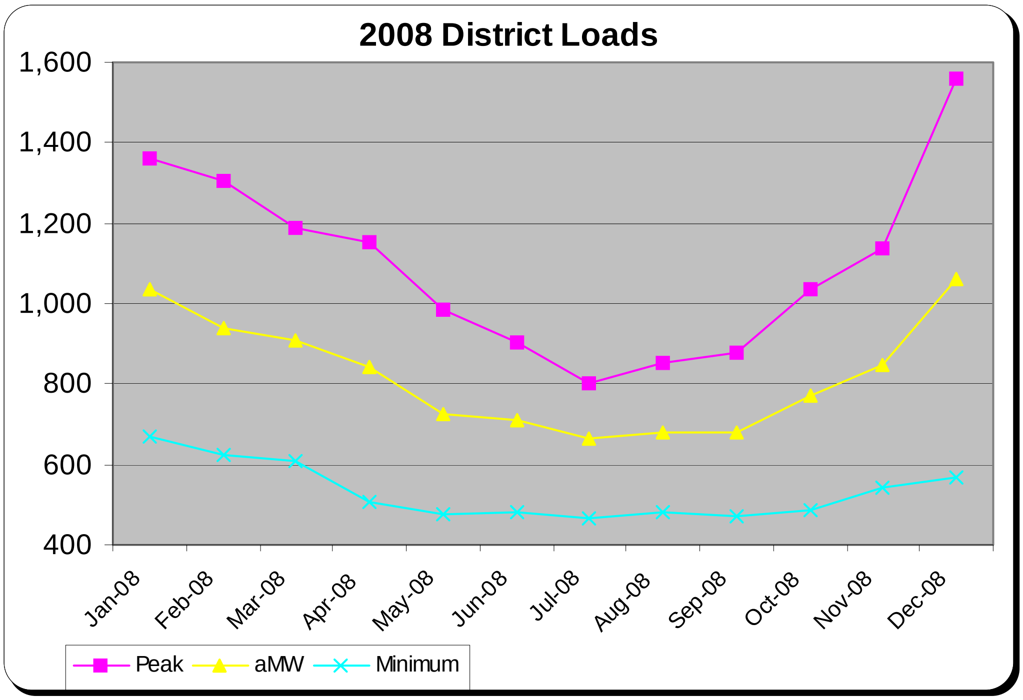


Figure E.3.1-14 Maximum, minimum, and average monthly system load (MW) for Snohomish County PUD.

E.3.1.2.5 Future Project Development

At this time, the District is not proposing to develop any additional generation or capacity during the term of a new license. However, in the future, if the District decides to add additional generation or capacity, if necessary, a license amendment request will be filed with FERC. The District will continue to look for increased electrical or mechanical efficiencies and hydraulic improvements.

Proposed alterations to the Powerhouse include installation of Pelton unit governor controls and use of flow deflectors to allow bypass and controlled downramping when these units trip off-line. These alterations will allow adherence to the proposed Project Operating Plan downramping rates at the Powerhouse.

No other development related to changes in capacity or generation is proposed at this time.

E.3.1.3 Environmental Measures

The District proposes to implement several environmental measures to protect, mitigate or enhance water quality, fisheries, native plant communities, wildlife habitat, listed species, recreation, and cultural resources. The full text describing each measure is presented in Appendix B. Detailed discussion of the effects of each measure is presented, by resource, in Section E.6.

Operations Plan: Implement the Operations Plan (attached as Appendix A) to operate the Project according to modified Spada Lake Reservoir Rule Curves in order to provide a balance of reliable municipal water supply, instream flows, incidental winter flood storage, higher lake levels for summer recreation and prevention or reduction of risk of spill following Chinook fall spawning and steelhead spring spawning. The Operating Plan incorporated several of the specific protection mitigation and enhancement measures related to Project operational impacts to aquatic habitat.

Water Quality Protection Plan: Develop and implement a plan to ensure and monitor compliance with Washington State water quality standards in the Sultan River, including (1) water quality protection measures related to Project construction or maintenance activities; (2) spill prevention and containment procedures; (3) procedures for application of herbicides, pesticides, fungicides, and disinfectants; and (4) measures for monitoring select water quality parameters, such as stream flow, temperature, and turbidity.

Aquatic Resource Committee: Establish and convene an Aquatic Resource Committee (ARC) to provide a mechanism for consultation regarding implementation of License Articles pertaining to aquatic resources.

Modify Minimum Instream Flows: Modify the specified minimum instream flows in the Sultan River below the Diversion Dam as measured at USGS Gaging Station No. 12137800 and Powerhouse as measured at USGS Gaging Station No. 12138160 to protect, mitigate, and enhance fish and wildlife resources, riparian vegetation, aesthetic resources, and water quality. Continue to provide 20 cfs in the bypass reach between Culmback Dam and the Diversion Dam for resident trout.

Modify the Maximum Flow Ceiling during the Chinook and Pink Salmon Spawning Period: Increase the maximum flow ceiling in OR-1 from 400 cfs to 550 cfs during the September 15 to October 15 peak spawning period and monitor redd locations to protect redds from being dewatered during the incubation period.

Process Flow Release Plan (PFR Plan): Develop and implement a plan to provide a water budget of 22,000 acre-feet total over the 50-year license term to provide controlled flows, supplement natural accretion flows, and support geomorphic and channel maintenance flow (collectively referred to as process flows).

Downramping Rate Conditions: Modify and refine the Project downramping rate schedules and formalize downramping frequency limitations to improve Project operation and minimize the risk of fish stranding.

Powerhouse Pelton Unit Flow Continuation System: Install a governor control system to bypass the Pelton turbine needle valve flow to the Sultan River. This measure is expected to greatly reduce the potential for an immediate reduction in Sultan River flow caused by inadvertent turbine or generator shutdown.

Large Woody Debris Plan (LWD Plan): Develop and implement a plan to install up to five LWD structures in the Sultan River to improve main channel habitat complexity and up to three LWD structures to improve mainstem/side channel connectivity.

Side Channel Enhancement Plan (SCE Plan): Develop and implement a plan to provide a minimum of 10,000 linear feet creating 3 acres of salmonid rearing habitat at side channel sites in the lower Sultan River.

Monitor Salmon and Steelhead Escapement: Continue to monitor steelhead trout and Chinook, pink, and chum salmon annual escapement in the Sultan River.

Steelhead Planting Program: Continue to fund the annual planting of 30,000 clipped steelhead smolts in the Snohomish basin.

Spada Lake Recreational Fishery Plan (SLRF Plan): Develop and implement a plan to improve fish access to tributary streams within the South Shore Road decommissioning zone, improve boating access to Spada Lake, and provide informative brochures to recreational anglers,

Juvenile Outmigration and Upstream Migration Flow Releases: Provide pulsed flows from the Powerhouse, for juvenile outmigration and adult upstream migration.

Reservoir Elevations: Attempt to maintain a minimum impoundment elevation in Spada Lake above 1,430 feet msl between July 1 and August 15 and above 1,420 feet msl from August 15 to September 15 to achieve higher summer elevation targets while assuring fall flood storage targets and providing for temperature conditioning in the Sultan River below Culmback Dam.

Maintain River Temperature within Stage I Range: Continue to operate the Project in a manner designed to maintain water temperatures within the pre-Stage II range downstream of the Diversion Dam.

Temperature Conditioning in Reach 3: Implement a program to condition the temperature of the water released at Culmback Dam, in order to provide a seasonally appropriate water temperature regime that will improve conditions for aquatic resources (including resident fish and macroinvertebrates) in Reach 3 of the Sultan River.

Noxious Weed Management Plan (NWMP): Implement the NWMP (attached as Appendix D), addressing control and containment of Washington State Class A, Washington State Class B Designate, Snohomish County Selected noxious weeds, and management of other selected weed species identified by the District and the adjacent land manager, U.S. Forest Service, within the Jackson Project boundary.

Terrestrial Resource Management Plan (TRMP): Implement the TRMP (attached as Appendix E) to protect and manage wildlife habitat on the Lost Lake, Project Facility Lands, Spada Lake, and Williamson Creek tracts.

Marbled Murrelet Habitat Protection Plan (MMHPP): Implement the MMHPP (attached as Appendix G), to protect habitat for this listed species and minimize the risk of disturbance during the breeding season.

Whitewater Recreation Plan (WR Plan): Develop and implement a 3-year trial period plan to evaluate provision of occasional higher flows in the Sultan River below Culmback Dam for whitewater boating, and upon completion of the trial, develop a Whitewater Recreation Recommendation (WR Recommendation) regarding whether the releases should be continued or modified.

Recreation Resources Management Plan (RRMP): Implement the RRMP (attached as Appendix H), including the four primary elements: 1) Recreation Sites and Use Areas Program (RSUAP), 2) Operations and Maintenance Program (OMP), 3) Recreation Monitoring and Reporting Program (RMRP), and 4) Interpretation and Education Program (IEP).

Historic Properties Management Plan (HPMP): Implement the HPMP (attached as Appendix I), including guidelines for evaluation, monitoring, management and avoidance of potential effects and defining specific actions to address effects on known or yet to be discovered eligible sites in the Project area.

E.3.2 Action Alternatives

During the ILP, none of the stakeholders proposed specific action alternatives for analysis, but several parties filed comments on the PM&Es as they were described in the PLP. The District's responses to these comments are provided in Appendix J. Several of the PM&Es now included in the District's proposal were modified based on these comments. The District is currently engaged in settlement negotiations with the stakeholders regarding potential alternatives to the proposed action.

E.3.3 No-Action Alternative

Under the no-action alternative, the District would continue to operate the Jackson Project under the terms and conditions of the current license, and no new environmental measures would be implemented. The no-action alternative serves as the baseline for comparing the effects of the District's proposal.

E.3.4 Alternatives Considered but Eliminated from Detailed Study

Two action alternatives were considered, but not carried forward for analysis. These include issuance of a non-power license and federal takeover of the Jackson Project.

E.3.4.1 Non-Power License

A non-power license is a temporary license that provides for removal of generation capabilities. The Commission would terminate a non-power license when it determined that another governmental agency would assume regulatory authority and supervision of the lands and facilities covered by the non-power license. However, no agency or other stakeholder has indicated an interest in assuming such authority, or indicated that the Jackson Project should not be operated to produce power. For this reason, the non-power license alternative has not been carried forward for analysis.

E.3.4.2 Federal Takeover

Section 14 of the Federal Power Act allows for federal takeover and operation of a hydropower Project, if FERC recommends and Congress approves such an action. To date, there is no situation in which FERC has exercised this option. No federal agency has indicated an interest in operating the Jackson Project, and for this reason, federal takeover is not considered further in this document.

E.4 CONSULTATION AND COMPLIANCE

E.4.1 Consultation

The Commission's regulations require license applicants to consult with appropriate resource agencies and other interested parties, or stakeholders, before filing their license applications. The following sections describe how the Commission and the District provided for this consultation.

E.4.1.1 Scoping

Compliance with NEPA requires any public agency that will permit or fund a major Project to evaluate the environmental and social consequences of the proposed action. Public involvement in the environmental review process is a key element of NEPA. Consistent with the public involvement aspect of relicensing, the Commission and the District conducted a publicly-noticed site visit to the Jackson Project on October 17, 2005 to allow participants to develop a basic understanding of the Project facilities and operations. The site visit was followed by the Commission's issuance of a scoping document (SD) on January 30, 2006 which identified preliminary resource issues and invited agency and public participation in scoping meetings that were held on February 27 and February 28, 2006. The Commission issued a second scoping document on May 2, 2006, which addressed the comments received during the meetings and during the subsequent comment period.

E.4.1.2 Consulting Framework

Over the course of the ILP, the District consulted with a variety of stakeholders (agencies, tribes, non-governmental organizations [NGOs], public) to discuss the Project, studies and PM&Es. These consultations were divided among the various resource areas (aquatic, terrestrial, cultural and recreation). These resource groups were notified of significant events, periodic updates, meeting announcements, and opportunities for written comments – for both ILP required and non-required events. As the FERC's non-federal representative for Endangered Species Act (ESA) Section 7 consultation and National Historic Preservation Act Section 106 consultation, the District informally consulted with the appropriate agencies and tribes as part of the resource groups during study plan implementation and results reporting. Agencies, tribes and NGOs consulted during the process are shown below in Table E.4.1-1. Their participation in various work groups is identified in Appendix K, the Consultation Record.

Table E.4.1-1 Agencies, tribes, and NGOs consulted during the ILP.

Federal Agencies	Tribes	State Agencies	Local Agencies and Municipalities	Non-governmental Organizations
Federal Energy Regulatory Commission (FERC)	Tulalip Tribes	Washington Department of Fish and Wildlife (WDFW)	City of Everett	American Whitewater
U.S. Forest Service (USFS)	Snoqualmie Tribe	Washington Department of Natural Resources (DNR)	City of Sultan	Trout Unlimited
U.S. Fish and Wildlife Service (USFWS)	Stillaguamish Tribe	Washington Department of Health (DOH)	Snohomish County Surface Water Management	Washington Prospectors Mining Association
National Marine Fisheries Service (NMFS)		Washington Department of Ecology (Ecology)		Washington Trails Association
National Parks Service (NPS)		Washington Department of Archaeology and Historic Preservation (DAHP)		Boeing Employees' Everett Prospectors Society
		Recreation Conservation Office (RCO)		North Cascades Conservation Council
				Hydro Reform Coalition
				Backcountry Bicycles Trails Club
				Cascade Land Conservancy
				Everett Mountaineers
				International Mountain Bike Association (Western WA)
				Snohomish Sportsmen Club

E.4.2 Compliance with Applicable Laws

In issuing hydropower Project licenses, the FERC must address any federal statutory and regulatory requirements that also apply to Project construction or operation. The major requirements are summarized below in Table E.4.2-1. Table E.4.2-1 also indicates the current status of the District's compliance with applicable laws.

Table E.4.2-1 Major statutory and regulatory requirements for the Jackson Project.

Requirement	Organization	Status
Clean Water Act, Section 401	Washington Department of Ecology	The District will apply for Section 401 water quality certification on September 27, 2009; certification is due by September 27, 2010.
Endangered Species Act	NMFS, USFWS	The District was designated as FERC's non-federal representative for ESA consultation on January 30, 2006. Section E.6.6 of this document serves as the District's Biological Assessment.
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	Section E.6.6 of this document presents the District's analysis of Project effects on Essential Fish Habitat (EFH), consistent with the requirements of the Magnuson-Stevens Act.
National Historic Preservation Act, Section 106	Washington SHPO, Tulalip Tribes, Snoqualmie Tribe, Stillaguamish Tribe	The District was designated as FERC's non-federal representative on January 30, 2006, for informal consultation. The District's proposed Historic Properties Management Plan is discussed in Section E.6.9, and the plan is attached as Appendix I.
Wild and Scenic Rivers and Wilderness Acts	Forest Service, USFWS, NPS, BLM	The Project is not located within Wild and Scenic Rivers or Wilderness designations and would not affect such designations.
Coastal Zone Management Act	Washington Department of Ecology	The Project is located within a coastal county and the District will apply for a determination of consistency with the CZMA.
Pacific Northwest Electric Power Planning and Conservation Act	Northwest Power and Conservation Council	The Project is not located within the Columbia Basin and would not affect Columbia Basin fisheries.

E.4.2.1 Clean Water Act, Section 401

Under Section 401 of the Clean Water Act of 1977 (CWA), a license applicant must obtain certification from the appropriate state pollution control agency that verifies compliance with the CWA. FERC regulations require that an applicant using the ILP file its request for water quality certification or waiver with the applicable agency within 60 days of the date FERC issues the notice of acceptance and REA. Consistent with these requirements, the District plans to file its application for water quality certification with the Washington Department of Ecology (Ecology) on September 27, 2009.

The District has consulted with Ecology throughout the relicensing process regarding the design and implementation of water quality studies needed to support its application for water quality certification. Section E.6.2 summarizes the results of water quality studies, analyzes Project effects, and discusses proposed water quality PM&Es. Appendix J summarizes our response to comments received from Ecology and others to the District's PLP. Appendix K provides a timeline of consultation with Ecology and other stakeholders regarding water quality.

E.4.2.2 Endangered Species Act

Section 7 of the Endangered Species Act of 1973 (ESA) requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat for such species. As FERC's designated non-federal representative, the District initiated informal consultation with USFWS and NMFS by reviewing the agencies' web sites (USFWS 2007a, www.fws.gov/westwafwo/speciesmap/SNOHOMIS.html; and NMFS 1996, www.nwr.noaa.gov/ESA-Salmon-Listings/Index.cfm) to identify listed and proposed species and critical habitat that could occur in the Project area. Review of the USFWS web site indicated that the District should evaluate potential Project effects on bull trout (*Salvelinus confluentus*), Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos*), northern spotted owl (*Strix occidentalist caurina*), and marbled murrelet (*Brachyramphus marmoratus*); and critical habitat for northern spotted owl and marbled murrelet. Review of the NMFS web site showed that Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*); and designated critical habitat for Chinook salmon are also present in the Project area. Section E.6.6 presents our Biological Assessment of these species, and forms the basis for the effect determinations shown in Table E.4.2-2, below. Consultation with USFWS and NMFS is summarized in Appendix K.

Table E.4.2-2 Effect determinations for listed species and findings regarding effects on critical habitat.

Species	Species Status	Species Finding	Critical Habitat Finding
Fish			
Chinook salmon, Puget Sound ESU (*Oncorhynchus tshawytscha*)	T	Likely to adversely affect	Not likely to adversely affect
Steelhead trout, Puget Sound DPS	T	Likely to adversely	Not applicable

Species	Species Status	Species Finding	Critical Habitat Finding
(*Oncorhynchus mykiss*)		affect	
Bull trout, Coastal Puget Sound DPS (*Salvelinus confluentus*)	T	Likely to adversely affect	Not applicable
Wildlife			
Canada lynx (*Lynx canadensis*)	T	No effect	Not applicable
Gray wolf (*Canis lupus*)	E	No effect	Not applicable
Grizzly bear (*Ursus arctos*)	T	No effect	Not applicable
Northern spotted owl (*Strix occidentalis caurina*)	T	Not likely to adversely affect	No effect
Marbled murrelet (*Brachyramphus marmoratus*)	T	Not likely to adversely affect	No effect

E.4.2.3 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Act as amended by the Sustainable Fisheries Act of 1996 established procedures designed to identify, conserve, and EFH for fish species that are regulated under a federal fisheries management plan. Under this act, EFH is defined as the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The consultation requirements of Section 305(b)(2) of the act specify that federal agencies must consult with the Secretary of Commerce on any actions that may adversely affect EFH. Section E.6.6 (*Rare, Threatened and Endangered Species*) provides our analysis of Project effects on three species - Chinook, coho, and Puget Sound pink salmon – that are protected under the act. Based on this analysis, we conclude that the proposed action would not adversely affect designated EFH for Chinook, coho and pink salmon in the Sultan River. Consultation with NMFS and other stakeholders regarding Project effects on Chinook, coho, and pink salmon is summarized in Appendix K.

E.4.2.4 National Historic Preservation Act, Section 106

Section 106 of the National Historic Preservation Act of 1966 requires the Commission to take into account the effect of licensing a hydropower Project on historic properties, and to allow the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed action. Historic properties include any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. Section E.6.9 of this document presents our analysis of Project effects on historic properties. As FERC's designated non-federal representative, the District initiated informal consultation with various cultural resource representatives.

Consultation with the State Historic Preservation Officer (SHPO), City of Everett, U.S. Forest Service (USFS), affected Indian tribes, and other stakeholders regarding historic properties is summarized in Appendix K.

E.4.2.5 Wild and Scenic Rivers and Wilderness Acts

Under the Wild and Scenic Rivers Act of 1968, FERC may not license hydropower projects located on or directly affecting any river that is designated as a component of the National Wild and Scenic Rivers System, or any river segment that Congress has designated for study. Designation under this act is intended to protect rivers with outstanding natural, cultural, and recreational values. The Sultan, Skykomish and Snohomish rivers are not designated or proposed for inclusion within the system. For this reason, relicensing the Jackson Project would not affect wild and scenic rivers.

The Wilderness Act of 1964 protects areas that are "untrammeled by man". Under this act, FERC may not license hydropower projects located within designated wilderness areas. The Jackson Project is not located within a wilderness area, and for this reason, relicensing the Project would not affect wilderness.

E.4.2.6 Coastal Zone Management Act

Section 307(c)(3) of the Coastal Zone Management Act (CZMA) of 1972 requires that federal licenses must be consistent with approved state coastal management programs. The Jackson Hydroelectric Project is located within a coastal county, and although neither current nor proposed Project operations would affect a designated coastal zone, the District will apply to Ecology for a determination of consistency with the CZMA concurrent with the Section 401 application for water quality certification.

E.4.2.7 Pacific Northwest Electric Power Planning and Conservation Act

Under the Pacific Northwest Electric Power Planning and Conservation Act of 1980, the Northwest Power and Conservation Council developed a program to protect, mitigate, and enhance fish and wildlife resources associated with development and operation of hydroelectric projects within the Columbia River basin. The Jackson Project is not located within, nor would it affect, the Columbia River basin.

E.5 PROJECT AREA AND SCOPE OF CUMULATIVE EFFECTS

E.5.1 General Description of the Sultan River Basin

E.5.1.1 Sultan River Basin

The Sultan River flows into the Skykomish River at RM 34.4. The Skykomish and Snoqualmie rivers join at Monroe (RM 20.5) to form the Snohomish River (Figure E.5.1-1). The Snohomish River watershed has a drainage area of 1,980 square miles and is the second largest river basin draining to Puget Sound (Haring 2002).

The Sultan River has a watershed area of approximately 110 square miles (FERC 1981). The basin is bounded on the east by the Cascade Mountains, on the north and south by lateral ridges extending westward from the Cascade crest, and on the west by the Puget Sound lowlands. Elevations in the basin range from the 6,617-foot msl summit of Del Campo Peak to 130 feet msl at the confluence of the Sultan and Skykomish rivers.

Downstream of Culmback Dam (RM 16.5), the Sultan River flows through a deep gorge for nearly 14 miles. The steep side slopes above the channel (Figure E.5.1-2) are densely forested with conifer and mixed deciduous growth. The river channel in this reach is relatively high gradient and confined, containing numerous cascades and rapids separated by short pool-riffle stretches. Much of the streambank is sheer rock face or large rock cuts (Williams et al. 1975). Near RM 3, the Sultan River emerges from the canyon reach onto a broad, relatively flat valley floor containing intermittent stands or strips of deciduous trees, underbrush and some mixed conifers. The river channel in this reach has a moderate gradient with a number of split channel sections.

Because of the steep topography in much of the basin and intense precipitation, the Sultan River, by nature, is a very “flashy” system, subject to extremes in maximum and minimum flows (see the Supplemental Paper to the Project Operating Plan in Appendix A). The Sultan Basin annually averages 163 inches of rainfall with variations as high as 214 inches and as low as 120 inches. November, December and January are the most rainfall intense with monthly averages of 27, 21, and 23 inches respectively. Daily precipitation in excess of 8 inches is not uncommon. The maximum measured daily rainfall of 11.57 inches was measured on November 11, 1990.

The average annual runoff is 768.5 cfs. Sultan River flows in excess of 34,600 cfs were measured twice in the 1950s at a gaging site just downstream of Culmback Dam. At the other extreme, Sultan River inflows to Spada Lake are sometimes no more than approximately 20 cfs in the months of July and August.

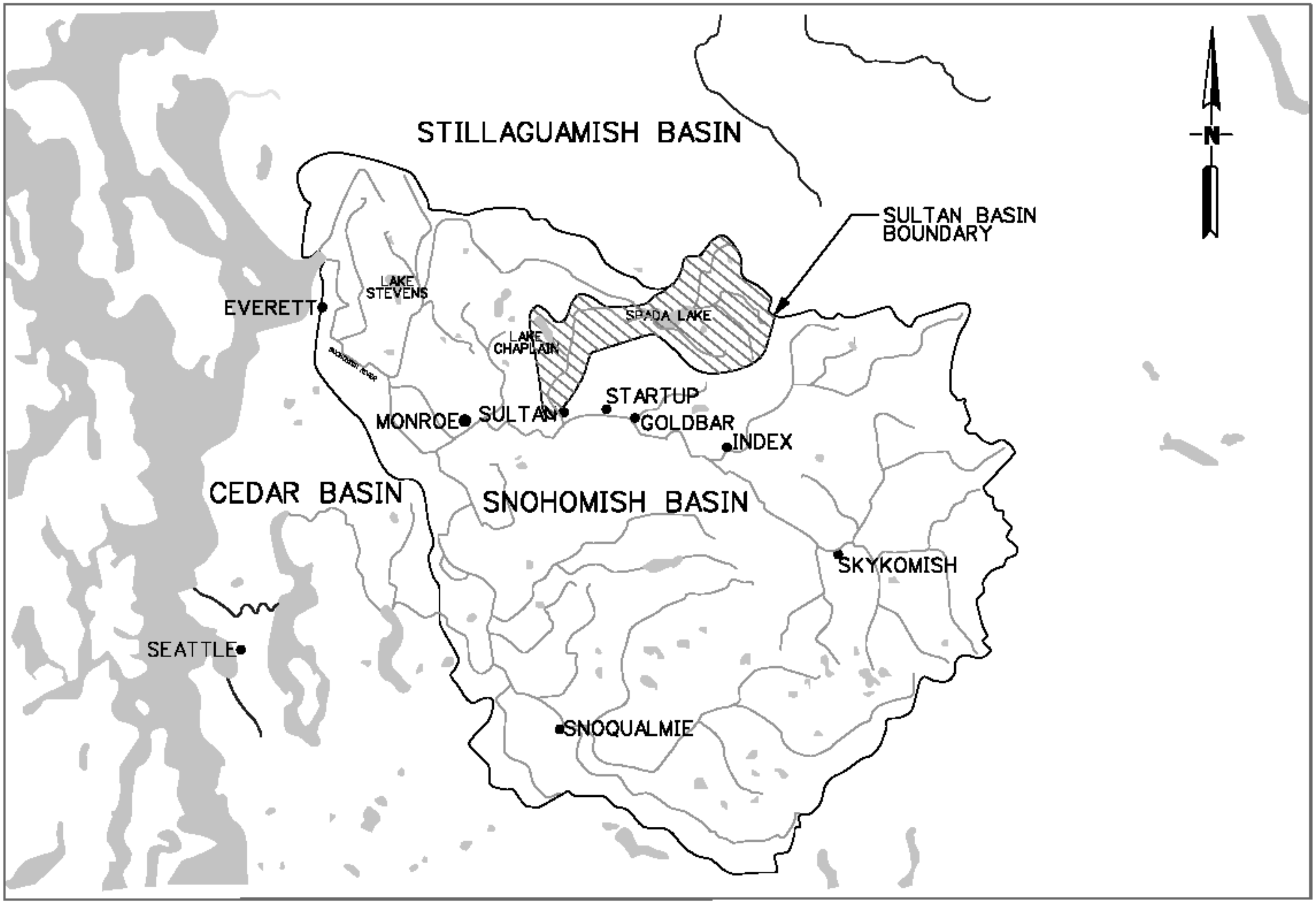


Figure E.5.1-1 Jackson Project location map.

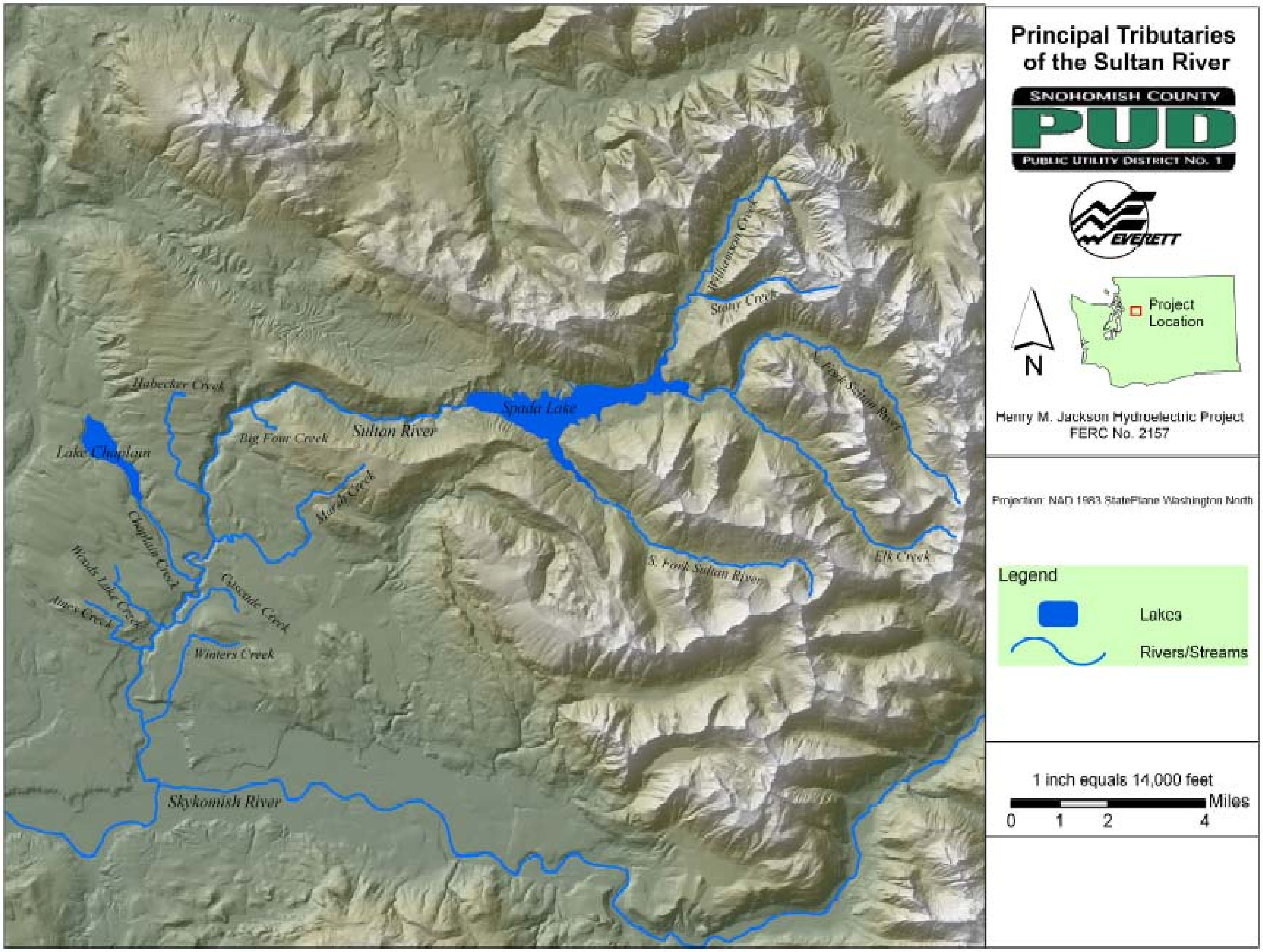


Figure E.5.1-2 Principal tributaries of the Sultan River.

E.5.1.2 Major Land Uses

The rugged topography of the Cascade Mountains and foothills dominates the Snohomish River basin, and lands used for timber production or forest recreation account for 74 percent of the basin area. Agriculture comprises 5 percent of the basin area, with farms covering the floodplains of the Snohomish River valley. These floodplains and rivers have historically been occupied and used by non-native Americans. The second largest land use in the basin (at 17 percent) is rural residential development which is scattered across the foothills and valleys (Pentec and EcoLogic 1996). Cities lying downstream of Spada Lake (the Project reservoir) along the Skykomish and Snohomish rivers include Sultan, Monroe, Snohomish, Marysville, and Everett (see Figure E.5.1-1). The nearest community is Sultan, approximately 16.5 miles downstream of the Project reservoir at the confluence of the Sultan and Skykomish rivers. Further downstream, near Monroe, the Skykomish and Snoqualmie rivers join to form the Snohomish River. The City of Monroe is located on the Skykomish River and the City of Snohomish is located along the Snohomish River. The largest urban development is concentrated in the cities of Everett and Marysville at the mouth of the basin, where the Snohomish River enters Puget Sound. The Project is located approximately 24 miles east of the City of Everett and the Interstate 5 (I-5) corridor.

The District owns over 4,400 acres of land within the Sultan River basin. Other major landowners in the Project area include the Washington Department of Natural Resources (DNR), United States Department of Agriculture (Mt. Baker-Snoqualmie National Forest), City of Everett, City of Sultan and private citizens (see the PAD for a detailed description of land ownership).

With approximately 45,000 acres, the State of Washington is the largest basin landowner, with its lands managed in two categories. The DNR manages approximately 18,600 acres for multiple purposes as state trust lands, with timber production being the primary use. Approximately 26,000 acres of DNR-managed land to the north, east, and the south of Spada Lake was added to adjacent Natural Resources Conservation Area (NRCA) lands on January 2, 2007, to form the Morning Star NRCA.

Private ownership in the upper watershed is limited to portions of a few sections of land. South of the Project Powerhouse, this characterization changes, and with the exception of a few State of Washington holdings, the land is all privately held. The Project power pipeline passes through three privately owned parcels of land beginning approximately 0.75 miles northeast of the Powerhouse.

E.5.1.3 Major Water Uses

Water stored in Spada Lake is used for the District's hydroelectric generation, City of Everett's municipal water supply (serving 80 percent of Snohomish County with drinking water), and to meet instream flow requirements in the Sultan River downstream of Culmback Dam. Water from Spada Lake is conveyed through a tunnel and pipeline directly to the Powerhouse at RM 4.5. Most is released to the river at this point after generating electricity, with the remainder conveyed through a pipeline up to the shores of Lake Chaplain, owned by the City of Everett, to the Portal 2 structure. At this point, flows are divided and released either into Lake Chaplin to supply the City's municipal and industrial customers, or through a tunnel to the new minimum flow release structure designed to meet instream flow requirements in the reach between the Diversion Dam and the Powerhouse.

E.5.1.4 Dams in the Basin

The only dams in the Sultan River basin are Culmback Dam and the City of Everett's Diversion Dam. Located at RM 16.5 on the Sultan River, Culmback Dam impounds Spada Lake, which has a storage capacity of 153,260 acre-feet. The Diversion Dam is located at RM 9.7, approximately 5.4 miles upstream of the Jackson Powerhouse. The Diversion Dam creates a small impoundment measuring less than 1 acre in size. Both of these dams are described in detail in Section E.3.1.1.

E.5.1.5 Tributary Streams

The principal tributaries to the Sultan River upstream of Culmback Dam include the South Fork Sultan River, North Fork Sultan River, Elk Creek, and Williamson Creek. The North Fork Sultan River, South Fork Sultan River, and Williamson Creek flow directly into Spada Lake. Downstream from Culmback Dam, principal tributaries include Big Four Creek, Habecker Creek, Marsh Creek, Chaplain Creek, Cascade Creek, Woods Creek, Ames Creek, and Winters Creek (Figure E.5.1-2). Chaplain Creek drains the area between Lake Chaplain and the Sultan River. Marsh Creek is the most significant tributary downstream of Spada Lake, in terms of drainage area and flow contribution.

Tributaries to the Sultan River exhibit typical mountain stream characteristics: steep gradients; narrow channels; numerous cascades and falls; and boulder and rubble substrate (Table E.5.1-1). Only Winters and Ames creeks, entering below the Powerhouse, have a moderate gradient over their lower reaches, good pool-riffle conditions and gravel bottoms. Most tributaries have dense forested cover (Williams et al. 1975).

Table E.5.1-1 Physical characteristics of major tributaries in the Sultan River basin.

Stream Name	Tributary to:	Stream Order[a]	Stream Length (miles)[b]	Average Gradient (percent)[b]
South Fork Sultan River	Spada Lake	2	3.3	16.1
North Fork Sultan River	Spada Lake	3	5.4	5.6
Elk Creek	North Fork Sultan River upstream of Spada Lake	3	4.9	3.2
Williamson Creek	Spada Lake	3	5.4	5.7
Big Four Creek (intermittent and impassable)	Sultan River upstream of Diversion Dam	1	0.9	22.6
Habecker Creek (intermittent and	Sultan River upstream of Powerhouse	1	2.7	6.4

Stream Name	Tributary to:	Stream Order[a]	Stream Length (miles)[b]	Average Gradient (percent)[b]
impassable)				
Marsh Creek (impassable)	Sultan River upstream of Powerhouse	2	5.4	7.4
Chaplain Creek (impassable)	Sultan River upstream of Powerhouse	1	1.2	2.8
Cascade Creek (impassable)	Sultan River downstream of Powerhouse	1	1.4	NA
Woods Creek (drains Woods Lake) (impassable)	Sultan River downstream of Powerhouse	2	3.0	3.3
Ames Creek	Sultan River downstream of Powerhouse	1	2.75	NA
Winters Creek	Sultan River downstream of Powerhouse	1	1.7	3.2

[a] Stream order from Strahler (1957).
[b] Based on USGS 7.5-minute quadrangles available for the Sultan River basin.
NA Not available

E.5.2 Cumulative Effects

According to the Council on Environmental Quality regulations for implementing NEPA, cumulative effects are impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. FERC in the scoping process indicated that the Project could have cumulative effects on water quantity and water quality, anadromous fish and bull trout, and old-growth forest.

E.5.2.1 Geographic Scope of Cumulative Effects Analysis

The geographic scope of cumulative effects analysis defines the physical limits or boundaries of the proposed actions' effects on the resources. Because the proposed action would affect the resource differently, the geographic scope varies for each resource.

E.5.2.2 Temporal Scope of Cumulative Effects Analysis

The temporal scope of the cumulative effects analysis covers all past, present and reasonably foreseeable future actions. Historic information is limited, and for this reason, the temporal scope focuses on the present and the proposed 50-year term of the new license.

E.6 ENVIRONMENTAL ANALYSIS

E.6.1 Geology and Soils

E.6.1.1 Affected Environment

E.6.1.1.1 Geologic Setting

The Jackson Project lies in the extreme western part of the North Cascade subdivision of the Cascade Mountain Physiographic Province where terrain ranges from 4,000 feet msl to over 10,000 feet msl in elevation. The Puget Lowland Province borders the Cascade Range to the west. In the western Cascade Physiographic Province, major rivers drain west across the Puget Lowland into Puget Sound. Alpine and continental glaciations have modified both the mountain valleys and the lowland topography (Snohomish County PUD and City of Everett 1979). The most important Project-related features produced by the continental ice are the Pilchuck plug immediately northeast of Culmback Dam, and the diversion of the modern Sultan River. A detailed discussion of the historic and current geologic and soil conditions in the Project area can be found in the PAD (Snohomish County PUD and City of Everett 2005)

Three major rock groups underlie the lower Sultan basin between Spada Lake and the Powerhouse. The oldest of these is a series of metasedimentary rocks composed largely of greywacke (dirty, well-cemented sandstone), argillite (dark, well-lithified rock composed of clay-sized grains), and phyllite (rock similar to argillite in which metamorphism has produced a sheet-like, foliated texture), and is considered to be part of the Nooksack Group of Jurassic and Cretaceous age. These sedimentary rocks have become consolidated as a result of metamorphic processes. They are hard and structurally competent.

Both Culmback Dam and the Powerhouse are founded in competent metasandstone and related rocks of the Nooksack Group of Jurassic and Cretaceous age; the power tunnel under Blue Mountain penetrates the same rock assemblage and metavolcanic rock of similar quality. All of these rock units are strong and sound, and the structures built on them are sound without producing any unstable slopes or potentially destructive geologic conditions. The pipeline linking the power tunnel with the Powerhouse is buried in unconsolidated deposits of glacial outwash and fill.

Among the primary geologic factors that influenced the design of the Project were seismic loading of Culmback Dam, landsliding at or near the dam, and potential seepage from Spada Lake through the glacial deposits of the Pilchuck plug. In accordance with standard engineering practice, the dam and abutments were monitored during filling in 1983-84 and have been periodically monitored since that time. No significant indications of seepage have been noted.

E.6.1.1.2 Faults

Based on review of available geologic literature and surface geologic mapping, it was concluded that there are no capable faults (movement or macroseismic activity within the past 35,000 years) within 20 miles of the dam site. This definition is in agreement with the current assessment of fault activity, as defined by the Corps of Engineers and cited in the 2006 Part 12 Dam Safety Inspection Report (MWH 2006).

E.6.1.1.3 Seismicity

The seismicity of the Project area was evaluated and the Project designed to accommodate the greatest intensity of seismic forces expected at the site on the basis of historical records. The US Bureau of Reclamation design standards applied to Culmback Dam recommended that a magnitude 7.0 to 7.5 event occurring at a distance of 8 miles be considered for design purposes (Woodward-Clyde Consultants 1990). This design earthquake would produce a median peak horizontal acceleration of 0.35 to 0.40g. Culmback Dam was assessed for this magnitude of quake and found to withstand these forces; therefore, it is expected to withstand the Maximum Credible Earthquake expected to impact its location (MWH 2006).

E.6.1.1.4 Soils

Major soil categories in the Sultan River basin include 1) shallow to moderate residual soils (2-5 feet deep), 2) deep residual soils, and 3) deep glacial soils (12 feet deep). Around Spada Lake, soils originated from mixed glacial and glacial lake deposits. Culmback Dam is situated on two soil types: shallow to moderately deep granitic, schist and metasedimentary soils; and very deep, well drained glacial and colluvial soils. The Powerhouse area is characterized by Everett gravelly soils and sandy loam (Snohomish County PUD and City of Everett 1979).

E.6.1.1.5 Reservoir Shorelines

Geologic conditions around the perimeter of Spada Lake are varied. Bedrock consisting of greywacke with interbeds of argillite is exposed in the southwest portion of the reservoir and intermittently along the southern and eastern portions. Glacial till deposits of various composition and density are extensive along the northern and northwestern areas of the reservoir.

Glacial till overlain by glacio-fluvial deposits consisting primarily of sand and gravel with varying amounts of cobbles and boulders is typical of the upper portion of the material around the reservoir area. The deposits, however, lie well above the level of the reservoir, as observed along road cuts. Surface drainage directed by road culverts and discharging over lacusterine deposits created washouts that have undermined roads in several locations.

Small landslides have also occurred on the reservoir slopes. These slides are narrow and are the result of normal erosion processes. Several such slides are present in the steeper banks lining the northwest corner of the reservoir and on the downstream side of the right abutment. The disturbed areas are localized and of limited extent (Snohomish County

PUD 1980a). Rapid landsliding capable of generating catastrophic waves in Spada Lake is not expected to occur.

About 48 acres of riparian forest lie along the Spada Lake shoreline between elevation 1,450 feet msl (normal maximum pool level) and 1,445 feet msl (normal full operational pool). This area was not cleared prior to filling of the reservoir in an effort to maintain a riparian forest around the perimeter.

E.6.1.1.6 Slope Stability

Much of the erosion and mass soil movements in the Sultan basin have occurred on the south side of the reservoir. In 1990, heavy rainfall combined with the effects of logging of very steep lands above the road from Olney Pass to Culmback Dam lead to mass material movement in several locations along the Culmback Dam Road (Pers. Comm., Bruce Meaker, Snohomish County PUD, August 9, 2005). These lands were logged by the U.S. Forest Service (USFS) prior to a land exchange that transferred ownership to the District in 1990. Several other road failures due to inadequate culvert sizing and poor subsurface foundations have occurred since 1990. In 2003, a massive slide occurred on the South Shore road between Olney Pass and the South Fork Bridge. This failure originated on DNR land and was addressed by that agency (Sarikhan and Pringle 2005).

In the fall of 2003 and in the winter of 2006, two separate massive landslides occurred on the south side of the Sultan River canyon below Culmback Dam. Beginning near the crest of the ridge leading to Blue Mountain, these mass movement fans impacted a substantial portion of the landscape, contributing a considerable volume of sediment and wood to the Sultan River and destroying several hundred feet of the USFS 6122 access road to the Sultan River. Another notable incident of mass soil movement in the Sultan River was documented in December 2004 by members of American Whitewater when a geologic fracture resulted in a large slide within the reach of the Sultan River downstream of the mouth of Marsh Creek. The deep gorge below the Diversion Dam is very steep and unstable, and periodically the bank will likely fail resulting in large amounts of rock, soil, and trees falling into the Sultan River. This same phenomenon occurred in 1988. These flow blockages are temporary and eventually washed downstream by the high flows.

E.6.1.1.7 Mineral Resources

Historic mining of metals was prominent in the Sultan-Index area of Snohomish County. Common ore minerals include pyrite, pyrrhotite, arsenopyrite, chalcopyrite, galena, and sphalerite (Phipps et al. 2003).

The 69-square mile Spada Lake basin has been the site of prospecting and mineral development for over 100 years. Prospecting in the region began after 1874, when silver was reported in Silver Creek district. As of 1945, four mines were in commercial production in the Williamson Creek and North Fork Sultan River drainages. All were hampered by the difficulty accessing the upper reaches of the basin; consequently, none of the mines had more than brief records of production (Phipps et. al 2003). Mine-to-market roads constructed in the 1940s accelerated operations, and sites in the South Fork and North Fork Sultan River drainages were active from the 1950s through the 1970s. Since then, a number of factors have combined to limit mining, including possible impacts to water quality in Spada Lake, establishment of Natural Resources Conservation Areas, and limited roaded access.

Prospecting and placer mining still occurs on National Forest System (NFS) lands in the Project area, although mining activity is minimal. Known activity includes assaying south of Culmback Dam and a 160-acre mining claim along the Sultan River below Culmback Dam (Phipps et al. 2003). Mining claims along the Sultan River are held by four different individuals/organizations and extend from Culmback Dam to the lower Sultan River.

E.6.1.2 Project Effects

E.6.1.2.1 Reservoir Shorelines

Reservoir fluctuations of 1.5 feet per day downward, or 20 feet per day upward are possible given the dramatic variation in basin hydrology. However, shoreline erosion around Spada Lake was not identified as a significant issue during study plan development and consultation for relicensing of the Jackson Project.

The District owns all of the lands surrounding Spada Lake and manages them as the Spada Lake Tract under their existing Wildlife Habitat Management Plan (Section E.6.4.1.2.2). Because combustion engine watercraft are not permitted on Spada Lake in order to protect the City of Everett's water supply, erosion of the reservoir shoreline due to boat wakes is not a concern. There is no commercial or residential development along the shoreline.

E.6.1.2.2 Slope Stability

The Jackson Project does not affect the stability of the slopes in the Project area. From RM 0 to RM 3, the Sultan River flows through a gentle sloping, low-elevation floodplain. Between RM 3 to RM 11, the river flows through a gorge bounded by terraces which periodically fail by deep-seated landsliding. Between RM 11 to RM 16.5, the river flows through a gorge in a V-shaped valley reach whose steep valley walls fail by debris flow landsliding (Stillwater Sciences and Meridian Environmental 2008a). Landslides have occurred periodically over time and will likely continue to occur because of the steep topography and unstable slopes in this reach.

Although the December 2004 Marsh Creek slide is not related to Project operation, the District investigated its effect on upstream fish movement during Phase 1 of the RSP 20 Evaluation of Fish Passage at the Diversion Dam (Ruggerone 2008). An additional investigation was conducted over the 2008-2009 winter season to identify options for altering the slide through engineered or mechanical means to allow fish greater upstream access without causing further slope instability. A report from this study was completed in April of 2009.

E.6.1.3 Proposed Environmental Measures

Issue

No issues relating to Project effects on geology or soils were identified during scoping.

Proposed PM&E

No PM&E measures are proposed specifically to address geology or soil issues. However, several of the proposed water resource PM&E measures would address issues that are likely to directly or indirectly affect gravel distribution and material accumulation from landslides throughout the river system.

Environmental Analysis

The District proposes to implement a variable instream flow schedule (as discussed in Section E.6.2.2, below), releasing flows to the river from a new discharge structure located adjacent to the City's Diversion Dam and from the Powerhouse. Additionally, a water budget of 22,000 acre-feet will be used to provide process flow releases up to 2,380 cfs (full capacity release) from Culmback Dam. Additional flow would be released as needed at the Powerhouse to achieve a process flow magnitude and duration of at least 3,300 cfs and 6 hours, respectively, as measured at USGS Gaging Station No. 12138160. These measures are intended to provide physical process related benefits to the aquatic habitat in the lower river (Section E.6.2.3.1.4).

E.6.2 Water Resources

E.6.2.1 Affected Environment

The Sultan River flows over 30 miles and includes at least 32 tributaries that total 123 linear stream miles in the drainage network. The watershed drains an estimated 110 square miles (FERC 1981). Major tributaries to the Sultan River above Culmback Dam include the South Fork Sultan River, North Fork Sultan River, Elk Creek, and Williamson Creek. Downstream of Culmback Dam, major tributaries include Marsh Creek, Chaplain Creek, Woods Creek (drains Woods Lake), Ames Creek, and Winters Creek (Figure E.5.1-2 and Table E.5.1-1).

Water stored in Spada Lake is used for hydroelectric generation, municipal water supply, and to meet minimum stream flow requirements downstream of Culmback Dam. Water is conveyed from the reservoir through a tunnel and pipeline directly to the Project's Powerhouse at RM 4.5. Most of the water passing through the Powerhouse turbines is discharged to the river at this point, with the remainder conveyed by the existing head through the Lake Chaplain pipeline to a control structure (Portal 2) near Lake Chaplain. Water flowing in the Lake Chaplain pipeline is divided at Portal 2 for municipal and industrial use by the City and for return flow at the Diversion Dam (RM 9.7) to meet minimum stream flow requirements (upstream of the Powerhouse). See sections E.3.1.1 and E.3.1.2 for a detailed description of Project operations, the Spada Lake reservoir and other Project facilities.

The following section briefly summarizes existing water resource attributes that are affected by Project operations, including water quantity and water quality parameters. A discussion of the effects of the Project (i.e. pre- to post-Stage II comparison) on water resource attributes is presented in Section E.6.2.2.

E.6.2.1.1 Water Quantity

Water yield in the Sultan River basin is derived from annual snow accumulation and precipitation. Owing to the steep topography and intense precipitation, the Sultan River by nature is a very “flashy” river system subject to rapid and extreme changes in flows. With an average annual rainfall measured at Culmback Dam of 163.4 inches, the basin has the highest runoff per unit area (11.0 cfs per square mile) of any gaged river system in the Puget Sound region (Pfeifer et al. 1998). Stream flow data have been collected in the Sultan River basin since 1911, and data are available from nine gaging stations located throughout the basin and are described in detail in (Snohomish County PUD and City of Everett 2005). Current Project operations affect two water quantity attributes, reservoir levels and Sultan River flows, as described below.

E.6.2.1.1.1 Reservoir Management

The reservoir rule curves are shaped to minimize spill (uncontrolled release of water via the spillway) and to store spring runoff for municipal water supply and minimum stream flow augmentation during the driest months. This strategy provides significant incidental floodwater storage. The reservoir rule curves are the key element in the Project's operating plan and fulfill the requirements of Article 57 of the current FERC License stipulating that the "Licensee and the Corps of Engineers shall enter into an agreement providing a reservoir operating rule curve for flood control, if any, and power operations." The design of the rule curves was based on two elements: (1) physical storage capacity of Spada Lake (153,260 acre-feet at full pool, 1,450 feet msl); and (2) upper Sultan River basin hydrology. The current rule curves (shown in Figure E.6.2-1) divide Spada Lake into four states that shift throughout the water year (July through June). The rule curves allow the District to provide incidental winter flood storage, municipal water supply, minimum stream flows, and higher summer lake levels for recreation. In States 1 and 2, the Project is required to discharge 1,300 cfs into the Sultan River. In State 4, the Project is operated to maintain Lake Chaplain within a specified range of elevation and to provide required minimum fishery flows below the Diversion Dam and Powerhouse. State 3 is a “discretionary” zone where the Project may be operated between the extremes of States 2 and 4, depending on the needs for power generation and subject to limitations on ramping rates and frequency.

On average, the reservoir water surface elevation is within State 3, except during periodic August and September low flows, when the Project is operated in State 4 to provide flood storage prior to the fall heavy rainy season (Figure E.6.2-1). Although reservoir surface elevations are generally within State 3, they vary widely seasonally and from year to year, with large variations in the fall to spring, but much less variation during the summer.

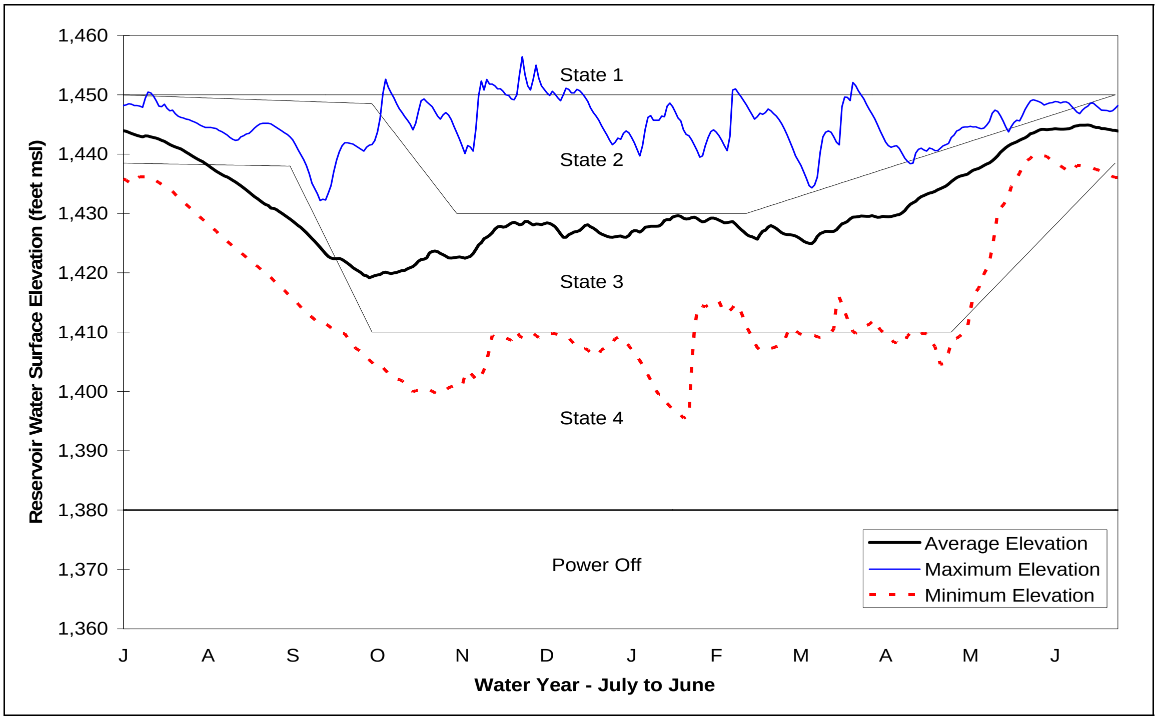


Figure E.6.2-1 Spada Lake daily minimum, maximum and average water levels observed (1990 to 2007) and operational rule curves.

During heavy storm events the Project is operated to provide incidental flood control. Spada Lake is the only flood control storage structure on the Skykomish River system and one of only two storage flood control structures in the Snohomish River system. Therefore, flood control was an important aspect of Stage II development, which raised Culmback Dam by 62 feet and increased the reservoir by 4.5 times in volume. At the time of Stage II development, the rigid prescription of reservoir management by the U.S. Army Corps of Engineers (Corps) to maximize flood control was not supported by either the licensees or the aquatic resource agencies due to the anticipated negative effects on downstream aquatic habitat resources. Therefore, under the current license, flood control is "incidental" to Project operations (i.e., an indirect outcome of the result of operating the Project for the other beneficial purposes). This was agreed to by the resource agencies and the Corps while developing the current license operating plan, which was finalized and accepted by the FERC in 1996.

The shape of the rule curves and the guidelines for operation are specifically designed to minimize flooding on the Sultan River. The Sultan River can constitute from 20 to 50 percent of the flood flows on the Skykomish River below the City of Sultan depending on the concentration of storm effects on the two river systems. The City of Sultan (population of approximately 5,000) is located at the mouth of the Sultan River where it joins the Skykomish River. The City's business district is located within the floodplain. Current operations of the Jackson Project have drastically reduced the medium-size floods on the Sultan River and reduced, to the extent reasonably possible, the effects of larger floods.

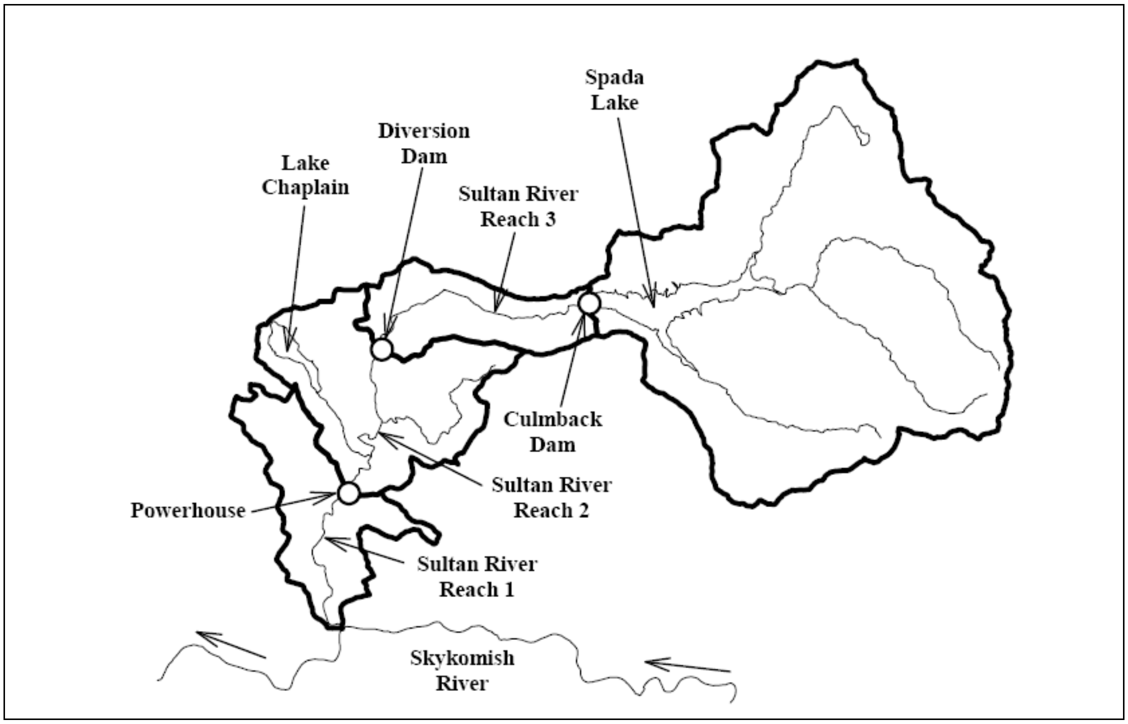
For example, during the Skykomish River basin flood event that occurred from January 6 to 8, 2009, the Spada Lake area received 18.32 inches of precipitation (9.5 inches in 1 day). To give perspective, the average precipitation in January is 23.3 inches. The storm event contributed about 50,000 acre-feet of water to Spada Lake. Of the approximately 18,000 cfs entering Spada Lake, all but 1,300 cfs was retained and, incidental flood management prevented a major flood event for the City of Sultan.

While Project operations can provide substantial flood flow reduction during single large storm events, the Jackson Project can not contain the larger multiple storm events that have historically occurred in the Sultan basin due to the relatively small size of the reservoir compared to potential inflows. While Project operations can absorb most or all of the first event, should a second event occur within two weeks, the reservoir may have little capacity to absorb it. Such a series of events occurred in 1990 (Water Year 1991). The first storm dropped 11.5 inches of rainfall in 24 hours on November 11. With an average daily inflow of 14,700 cfs, Spada Lake rose 22 feet in 24 hours, resulting in a modest spill of about 3,000 cfs. Operating at full generation, the reservoir was only lowered to about 2.5 feet below the rim of the spillway when 2 weeks later, the second multi-day storm arrived. Inflows to Spada Lake increased to 18,000 cfs which resulted in the lake level rising nearly 7 feet over the top of the spillway and a peak spill flow of nearly 17,000 cfs. Multiple storm events resulting in spill events of this magnitude are relatively rare.

E.6.2.1.1.2 Sultan River Flows

As discussed in the previous section, Project operations largely control Sultan River flows below Culmback Dam, except for additional flows contributed by a few minor tributaries and during large multiple storm events that cause spill. The District holds a water right authorizing diversion of 556 cfs and 250,200 acre-feet per year from the Sultan River for power generation (Certificate No. S1-00732C, priority date May 3, 1946); and the District and the City jointly hold a second water right authorizing diversion of 1,500 cfs and 506,800 acre-feet per year of water from the Sultan River for power generation and municipal water supply purposes (Certificate No. S1-23398C, priority date June 15, 1979). The withdrawal of water from the Sultan River basin by the City of Everett, while affecting Sultan River flows, is not part of the hydroelectric Project. Information about the City's water withdrawal and projected future demand is discussed under Cumulative Effects (Section E.6.2.4).

Based on Project water routing and minimum stream flow requirements, the Sultan River basin downstream of Culmback Dam can be divided into three distinct operational reaches (Figure E.6.2-2): Operational Reach 3 (OR-3) from Culmback Dam (RM 16.5) to the Diversion Dam (RM 9.7); Operational Reach 2 (OR-2) from the Diversion Dam (RM 9.7) to the Powerhouse (RM 4.5); and Operational Reach 1 (OR-1) from the Powerhouse (RM 4.5) to the Skykomish River (RM 0.0). Existing minimum stream flow requirements, seasonal flows, peak flows, and Project flow ramping are summarized below. A more detailed discussion of flows in relation to Project operations is presented in Section E.6.2.2.



Source: R2 Resource Consultants 2008b

Figure E.6.2-2 Operational Reaches 1, 2, and 3 on the Sultan River below Culmback Dam.

Minimum Stream Flow Requirements

Flow releases from Culmback Dam to the Sultan River have been regulated since 1965 (prior to the hydroelectric Project). A Settlement Agreement in 1982 (pertaining to the hydroelectric Project) with the Washington Department of Fish and Wildlife (WDFW), the National Marine Fisheries Service (NMFS), and the Tulalip Tribes (the "Joint Agencies") established three controlled flow release points on the Sultan River: Culmback Dam (RM 16.5), the Diversion Dam (RM 9.7) and at the Powerhouse (RM 4.5), where flows are monitored to protect, mitigate and/or enhance aquatic resources. A constant minimum stream flow of 20 cfs is released from Culmback Dam to the Sultan River. Between the Diversion Dam and the Jackson Powerhouse, a minimum stream flow of 95 to 175 cfs is required to support fishery resources as determined by the Joint Agencies. This level varies seasonally, with flows supplied primarily by return flow using the Lake Chaplain pipeline. From the Powerhouse to the Sultan's confluence with the Skykomish River, minimum stream flow requirements range from 165 to 200 cfs (Table E.6.2-1).

Table E.6.2-1 Sultan River minimum stream flow requirements.

Dates	Point of Discharge	Minimum Stream Flow (cfs)
All Year	Culmback Dam[a]	20
11/1 – 1/15	Diversion Dam[b]	95
1/16 – 2/28	Diversion Dam[b]	150

Dates	Point of Discharge	Minimum Stream Flow (cfs)
3/1 – 6/15	Diversion Dam[b]	175
6/16 – 9/14	Diversion Dam[b]	95
9/15 – 9/21	Diversion Dam[b]	145
9/22 – 10/31	Diversion Dam[b]	155
6/16 – 9/14	Powerhouse[b]	165
9/15 – 6/15	Powerhouse[b]	200[c]

[a] Cone valve discharge verified by the U.S. Geological Survey on August 28, 1990.
[b] Telemetry gages are installed immediately below the Diversion Dam and Powerhouse to monitor these flows.
[c] If flows exceed 400 cfs during the Chinook spawning period (September 15 to October 15), the District increases minimum stream flows during the subsequent incubation period to protect spawning redds.

Winter Steelhead Fishery Recreational Flow

In addition to managing flows specifically for aquatic resources, the District provides recreational opportunities for steelhead anglers by controlling flows during the winter steelhead fishing season (December through February). This modified operating regime, if feasible, occurs on the weekend following the 14th consecutive day of Project-created flows exceeding 700 cfs, commencing on Saturday at 1200 hours. The discharge from the Powerhouse is reduced in accordance with established down-ramping rates to provide a stream flow of 700 cfs or less until 2400 hours on Sunday. The total flow reduction period is 36 hours and allows steelhead anglers to access the river under favorable flow conditions during the weekend of the flow reduction.

Criteria triggering this recreational flow include:

- Spada Lake water surface elevation must be below 1,435 feet msl and decreasing;
- Meteorological and hydrological forecasts for the Snohomish River basin must be favorable; and
- The U.S. Army Corps of Engineers must not object if Spada Lake will still be in State 2 of the rule curve.

Seasonal Sultan River Flows

The combined minimum stream flow release from Culmback Dam, infrequent spill events from Spada Lake, and contributions from a few small unnamed drainages and Big Four Creek supply flow to the Sultan River in the 6.8-mile-long bypass reach. In addition to the constant 20 cfs release from Culmback Dam, accretion flows in Reach OR-3 (bypass reach) are variable and range from about 10 to 2,000 cfs, depending on precipitation. One USGS gaging station (Sultan River near Startup gage) was located between Culmback Dam and the Diversion Dam, but was discontinued in 1971. Therefore, current data is not available to describe existing flow conditions in the bypass reach under Stage II.

Sultan River flows downstream of the Diversion Dam in Reach OR-2 are a combination of releases from Culmback Dam, accretion flows in the bypass reach, and return flows from the Lake Chaplain pipeline. Additional flow is contributed to this reach from Marsh and Chaplain creeks and a few smaller drainages such as Habecker and Cascade creeks. The Sultan River below Diversion Dam gage (USGS Gaging Station 12137800) was installed in 1983 and is currently one of two compliance points for Sultan River minimum stream flow requirements listed in Table E.6.2-1. Median (i.e. 50 percent exceedence level) and minimum stream flows in this reach are generally well below 300 cfs all year long with higher flows occurring in October and November (Figure E.6.2-3).

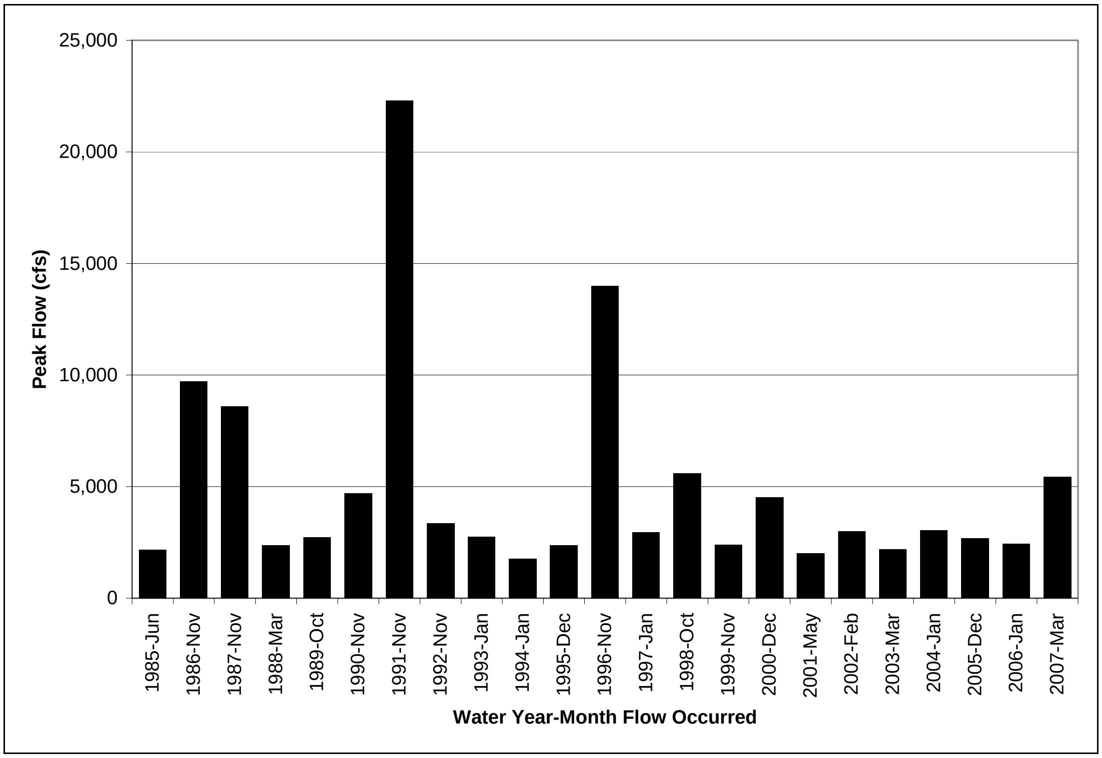


Figure E.6.2-3 Peak flows by water year with month of occurrence listed (Sultan River below Powerplant gage, USGS Gaging Station 12138160).

Woods Creek (draining Woods Lake), Ames Creek, and Winters Creek are the principal tributaries contributing flow to the Sultan River downstream of the Powerhouse in Reach OR-1. A few unnamed tributaries also discharge to this reach. One USGS gaging station is located downstream of the Powerhouse - the Sultan River below Powerplant gage (USGS Gaging Station 12138160). This station was installed in 1983 and is a compliance point for Project minimum stream flow requirements downstream of the Powerhouse. Low flows generally occur in August and September and high flows occur in November. Median (i.e. 50 percent exceedence level) flows are generally less than 1,000 cfs in the winter and spring and less than 300 cfs in summer, but rise to about 1,500 cfs during fall (Figure E.6.2-4).

Peak Flows

During the past 23 years under existing Project operations, peak flows below the Powerhouse have exceeded 10,000 cfs twice, reaching 22,300 cfs in water year 1991 and 14,000 cfs in water year 1996 (Figure E.6.2-5). Usually peak flows below the Powerhouse occur from November through January and are less than 3,000 cfs in magnitude.

Flow Fluctuations (Ramping)

To fulfill the requirement of the current FERC License Article 55 for fish protection and mitigation related to Project-controlled river flow changes (referred to as "ramping"), the District conducted field studies in 1985 and 1986 on the effects of flow decreases ("downramping") on young salmonids (Olson 1990). The study was developed cooperatively with the Joint Agencies, and informed the development of a revised Project Operating Plan, approved by FERC, that sets the downramping rates for the Project at the Powerhouse (Table E.6.2-2). In 2004 and 2005, the District conducted an additional assessment of Project operational effects on ESA-listed salmonids and bull trout (CH2M Hill 2005). Following informal consultation with the Joint Agencies, further ramping rates at the Diversion Dam were adopted as a conservation measure that range from 1 to 6 inches per hour (Table E.6.2-3).

Table E.6.2-2 Jackson Hydroelectric Project Powerhouse downramping rate schedule [a] (inches/hour).

Flow Range (cfs/day)	Day	Night	Day	Night
	March 1[b] to May 31		June 1[b] to September 15	
1,500 to 750	4	4	2	1
750 to 600	2[c]	2[c]	2[c]	1[c]
600 to 300	2	4	2	1[d]
300 to minimum	2	2	2	1[d]
	September 16 to October 31		November 1 to February 28	
1,500 to 750	2	1	4	4
750 to 600	2[c]	1[c]	2[c]	2[c]
600 to 300	2	2	4	4
300 to minimum	2	2	4	4

[a] For normal operation; not for power generation equipment failures or forced outages. Values are in inches-per-hour at the Powerhouse. Rates are tracked on a 15 minute basis by USGS for compliance. No one 15 minute downramping value will exceed half the hourly rate shown in the table. No four consecutive downramping rates shall exceed the hourly rates shown in the table.

[b] This date may be adjusted annually by determining time of fry emergence with cumulative water temperature information. Upon notification to the District from WDFW that either salmon or steelhead trout fry are expected to emerge from the river gravel, based on water temperature unit calculations, the District will shift to the designated slower downramping rates.

[c] If river flow prior to downramping has exceeded 1,000 cfs for more than 72 hours, downramping through this flow range (750 to 600 cfs) occurs only after holding flow constant between 750 and 850 cfs for at least 6 hours of daylight and one overnight period.

[d] Avoid any scheduled flow reduction.

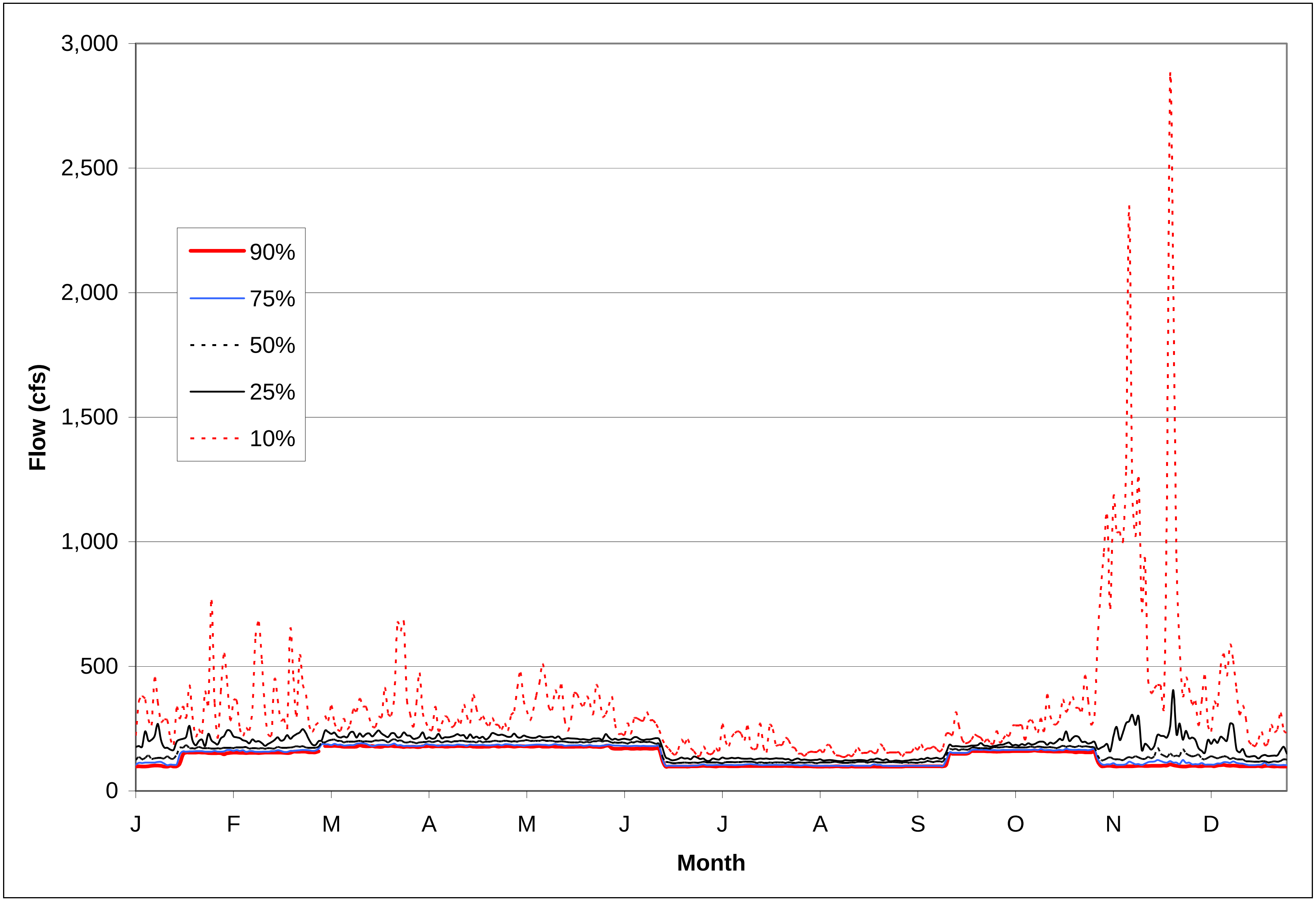


Figure E.6.2-4 Daily flow exceedence for the Sultan River below Diversion Dam gage (USGS Gaging Station 12137800), 1983-2007.

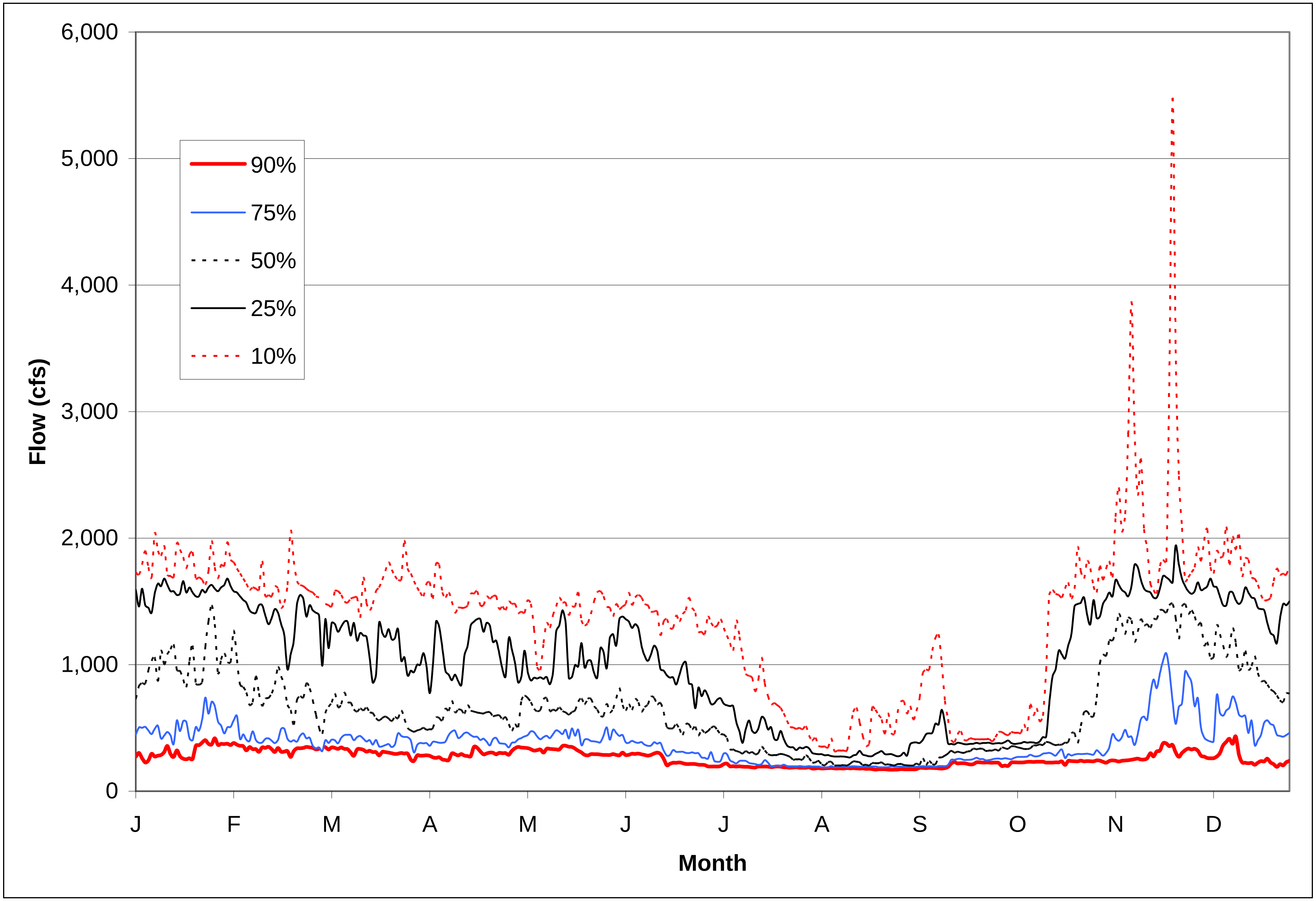


Figure E.6.2-5 Daily flow exceedence for the Sultan River below Powerplant gage (USGS Gaging Station 12138160), 1983-2007.

Table E.6.2-3 Diversion Dam downramping rate schedule[a].

	Day	Night	Day	Night
	Jan. 1[b] to May 31		June 1 to Sept. 15[c]	
Ramp Rate (in/hr)[d]	3	3	3	1.5
	Sept. 16 to Oct. 31		Nov. 1 to Dec. 31	
Ramp Rate (in/hr)	3	3	6	6

[a] For normal operations in the flow range between 95 cfs (minimum stream flow) and 300 cfs, not during power generating equipment failures, forced outages, or gravel flushing/enhancement actions requiring manual operation of the sluice gate at the Diversion Dam.

[b] Chinook salmon fry emergence schedule will be determined yearly in consultation with WDFW.

[c] Avoid any scheduled flow reduction.

[d] Units are in inches per hour as measured at the USGS gaging station downstream from the Diversion Dam. Rates are tracked on a 15-minute basis. No single 15-minute downramping value will exceed one half the hourly value shown in the table. The average of four consecutive 15-minute downramping rates shall not exceed the hourly rate shown in the table.

Most downramping occurs when the reservoir is in State 3, which is the operational “discretionary” zone. Downramping rates are limited to the schedule presented in Table E.6.2-2 and vary from 1 to 4 inches per hour, depending on the season, time of day, and river stage. The point of compliance is immediately downstream of the Powerhouse. If downramping occurs during the twilight period (1 hour before to 1 hour after sunrise or sunset), the lower of the two stipulated day or night rates is used. This precautionary guideline minimizes the potential for stranding during the twilight hours when the juvenile fish are shifting their diurnal behavior patterns. Additionally, because the Project is not operated on a “load-following basis”, Powerhouse discharges to the river do not fluctuate frequently on a daily basis[4].

E.6.2.1.2 Water Quality

The overall water quality in the Sultan River in the vicinity of the Project is very good. The Sultan River basin is a relatively remote watershed characterized by rugged forested terrain, and is one of the wettest watersheds in the continental United States with average annual precipitation of about 165 inches. These conditions result in surface waters in the basin that have dilute dissolved solids and ions content, and are free of pollutants or contaminants. The Sultan River basin has been protected as the source of the City of Everett’s municipal water supply since 1917. This protection restricts the range of recreational and other activities that may occur in the Project area, which further limits the potential for anthropogenic effects on water quality.

A two-year Water Quality Parameter Study was completed in March 2009 to obtain information on existing water quality conditions in the vicinity of the Project. The Water Quality Parameter Study assessed 19 parameters at 13 sampling sites in the vicinity of the Project over the period from April 2007 through March 2009. Descriptions and analysis

[4] A project operated on a load-following basis would generally require frequent upramping and downramping to respond to changing demands for energy during a given day.

of the data obtained during the two-year study are provided in the Water Quality Final Technical Report (CH2M HILL 2009).

The 2-year study confirms that water quality conditions in the vicinity of the Project are very good, as previously reported by Pfeifer et al. (1998) and further documented in the Jackson Project PAD (Snohomish County PUD and the City of Everett 2005) and the Revised Study Plan (Snohomish County PUD and the City of Everett 2006a). Results of the study also indicate that conditions in the vicinity of the Project conform to Washington State water quality standards (per Chapter 173-201A of the WAC) throughout the year with few exceptions (as summarized further in the sections that follow).

These results will support an application to Ecology for Section 401 Certification of the Project under the Clean Water Act. This 401 Certification is needed prior to FERC's issuance of new license for the continued operation of the Project, and will affirm that waters potentially affected by the Project conform to state water quality standards and support designated beneficial uses. The overall goal of state water quality standards is to prevent the degradation of waters of the state and to maintain existing and designated uses. Beneficial uses and water quality criteria applicable to waters in the vicinity of the Project are summarized below.

E.6.2.1.2.1 Designated Uses and Water Quality Standards

Designated freshwater uses in the state standards include subcategories under aquatic life, recreation, water supply, and miscellaneous uses. The entire Sultan River basin is designated for domestic, industrial and agricultural water supply and stock watering; wildlife habitat; timber harvest; commerce and navigation; boating; and aesthetics. The entire Sultan River basin is designated as Core Summer Salmonid Habitat for which specific numerical criteria are established for five of the water quality parameters applicable to the Sultan River basin as summarized in Table E.6.2-4. In addition, the Sultan River, from its mouth to the Chaplain Creek confluence, is designated for Primary Contact recreation[5], and for Extraordinary Primary Contact recreation[6] upstream of this point. The state standards for contact recreation that apply to the Sultan River basin are based on fecal coliform bacteria criteria as summarized in Table E.6.2-5.

Other state standards are in effect for lakes (or reservoirs), like Spada Lake, which are distinguished from riverine systems as being waterbodies with a mean detention time[7] of greater than fifteen days. The state standards for a lake or reservoir are summarized in Table E.6.2-6.

[5] "Primary contact" means activities where a person would have direct contact with water to the point of complete submergence including, but not limited to, skin diving, swimming, and water skiing, although these activities are not allowed in Spada Lake due to water supply concerns.
[6] "Extraordinary primary contact" means waters providing extraordinary protection against waterborne disease or that serve as tributaries to extraordinary quality shellfish harvesting areas.
[7] "Mean detention time" means the time obtained by dividing a reservoir's mean annual minimum total storage by the thirty-day, ten-year low-flow from the reservoir.

Table E.6.2-4 Summary of relevant state water quality standards for Core Summer Salmonid Habitat.

Parameter	Standard
Water Temperature	Not to exceed 7-DADMax[1] of 16.0ºC[2]
Total Dissolved Gas	Not to exceed 110% of saturation.
Turbidity	Not to exceed 5 NTU over background, or 10% over background of 50 NTU or more.
Dissolved Oxygen	Must exceed 9.5 mg/l.
pH	Within 6.5 to 8.5[3].

[1] 7-day average of the daily maximum temperatures.

[2] When a water body's temperature is warmer than the applicable criteria (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F). (ii) When the background condition of the water is cooler than the applicable criteria, the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows: (A) Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 28/(T.+7) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge); and (B) Incremental temperature increases resulting from the combined effect of all non-point source activities in the water body must not, at any time, exceed 2.8°C (5.04°F). (iii) Temperatures are not to exceed the criteria at a probability frequency of more than once every ten years on average.

[3] Human-caused variations must be within a range of 0.5 pH units.

Table E.6.2-5 State water quality standards for Extraordinary and Primary Contact Recreation - fecal coliform parameter.

Parameter	Extraordinary	Primary Contact
Fecal coliform	Not to exceed geometric mean of 50 col./100 ml, less than 10% of all samples exceeding 100 col./100 ml.	Not to exceed geometric mean of 100 col./100 ml, less than 10% of all samples exceeding 200 col./100 ml.

Table E.6.2-6 Summary of other relevant state water quality standards for lakes (relevant to Spada Lake).

Parameter	Standard
Water Temperature	Not to increase 7-DADMax more than 0.3ºC above natural conditions[1]
Dissolved Oxygen	Not to decrease minimum daily DO more than 0.2 mg/L below natural conditions[1].
Nutrient Criteria	Establishes lake trophic state[2] based on ambient Total Phosphorus (TP).

[1] “Natural conditions” means surface water quality that was present before any human-caused pollution.

[2] "Trophic state" means a classification of the productivity of a lake ecosystem. Lake productivity depends on the amount of biologically available nutrients in water and sediments and may be based on total phosphorus (TP). Trophic states used in this rule include, from least to most nutrient rich, ultra-oligotrophic, oligotrophic, lower mesotrophic, upper mesotrophic, and eutrophic..

E.6.2.1.2.2 Project-Related Water Quality Data

This section describes water quality conditions in the vicinity of the Project for parameters associated with state water quality standards (per Chapter 173-201A WAC), as well as for other parameters useful to inform evaluation of aquatic resources. Descriptions are provided of the data collected from April 2007 through March 2009 during the 2-year Water Quality Parameter Study. The Water Quality Parameter Study sampling sites are shown in Figure E.6.2-6. The Water Quality Final Technical Report (CH2M Hill 2009) provides further descriptions and analysis of the data obtained during the study.

Water Temperature

Water temperature conditions upstream of the Project in the tributaries entering Spada Lake follow a typical annual trend with maximum temperatures occurring during mid-summer and minimum temperatures in winter. The data collected during the 2-year water quality study indicate that maximum temperatures occurred in July and August, with the 7-DAD Max reaching 13.9 degree Centigrade (ºC) at the South Fork Sultan River (SF) site, 14.4ºC at the North Fork Sultan River (NF) site, and 15.3ºC at the Williamson Creek (WC) site. Minimum temperatures at these sites during the two-year study occurred January through March at about 1 to 2ºC. As such, the 7-DAD Max values at these sites did not exceed the designated Core Summer Salmonid Habitat temperature criterion of 16°C at any time during the study.

Spada Lake undergoes typical thermal stratification during warmer months of the year, and is isothermal (i.e., uniformly-mixed and not stratified) during other colder months. These conditions are evident in Figure E.6.2-7, which shows the trends during 2007 of daily mean temperatures in various depth strata in Spada Lake as measured at the intake tower. Thermal stratification of the lake usually begins in May and lasts until late October. During maximum stratification in August and September, the average surface water temperature is about 18 to 19°C and bottom temperatures average about 5 to 6°C, with the thermocline about 40 to 60 feet from the surface. The lake's temperatures drop to a low of about 2 to 4°C throughout the water column in mid-winter. The water temperature data in Spada Lake for the entire Water Quality Parameter Study are presented in the Water Quality Final Technical Report (CH2M Hill 2009).

Water temperature conditions in the Sultan River downstream of Spada Lake (Culmback Dam) also follow a typical annual trend with maximum temperatures in mid-summer and minimum temperatures in winter. These trends are evident in Figure E.6.2-8, which shows 7-DAD Max temperatures at the downstream Sultan River sites during 2007. The water temperature data at these sites for the entire 2-year Water Quality Parameter Study are presented in the Water Quality Final Technical Report (CH2M Hill 2009).

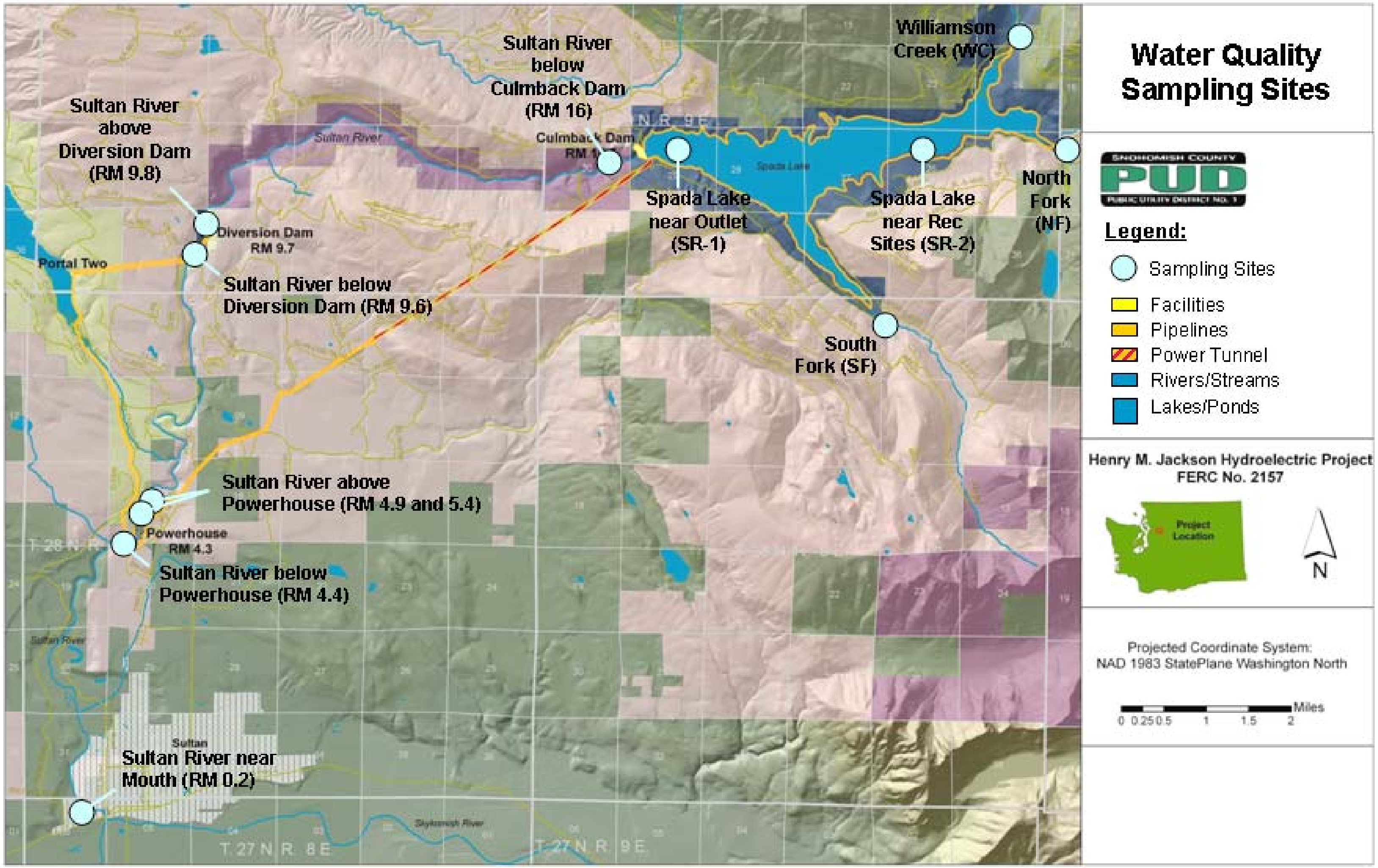
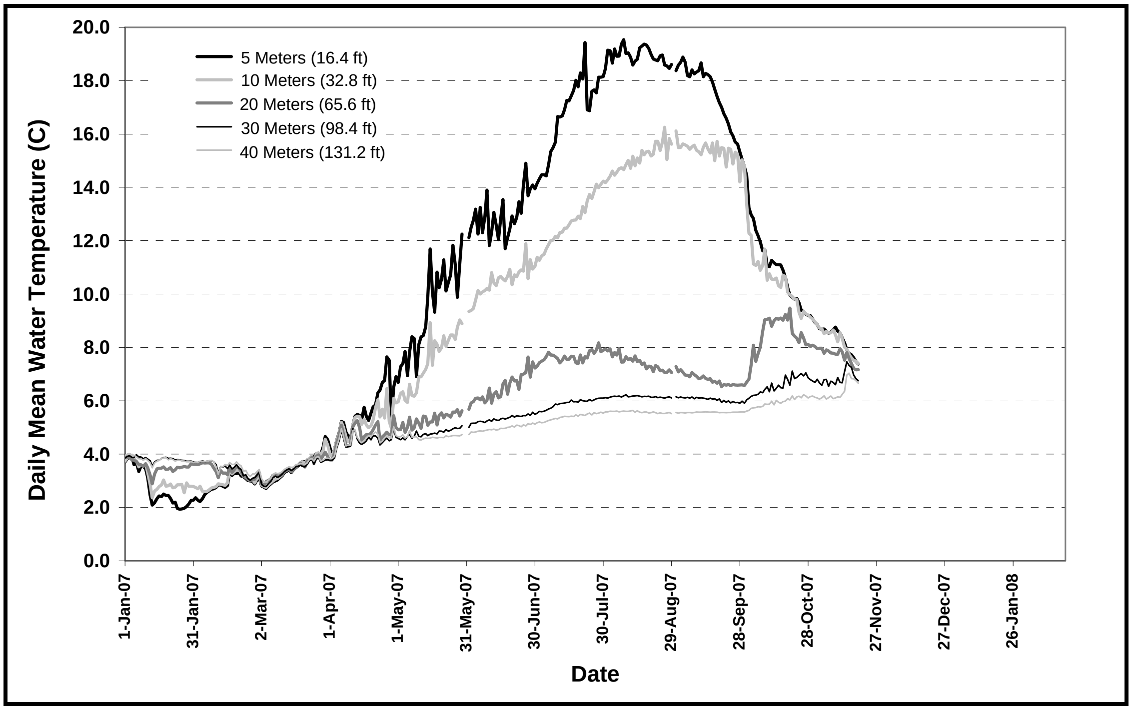


Figure E.6.2-6 **Locations of water quality sampling sites.**



Note: Data for the intake tower during 2007 are only available up to December due to inaccessibility (from inclement weather) to instruments.

Figure E.6.2-7 Daily mean temperatures (°C) in Spada Lake during 2007 as measured at the intake tower by depth.

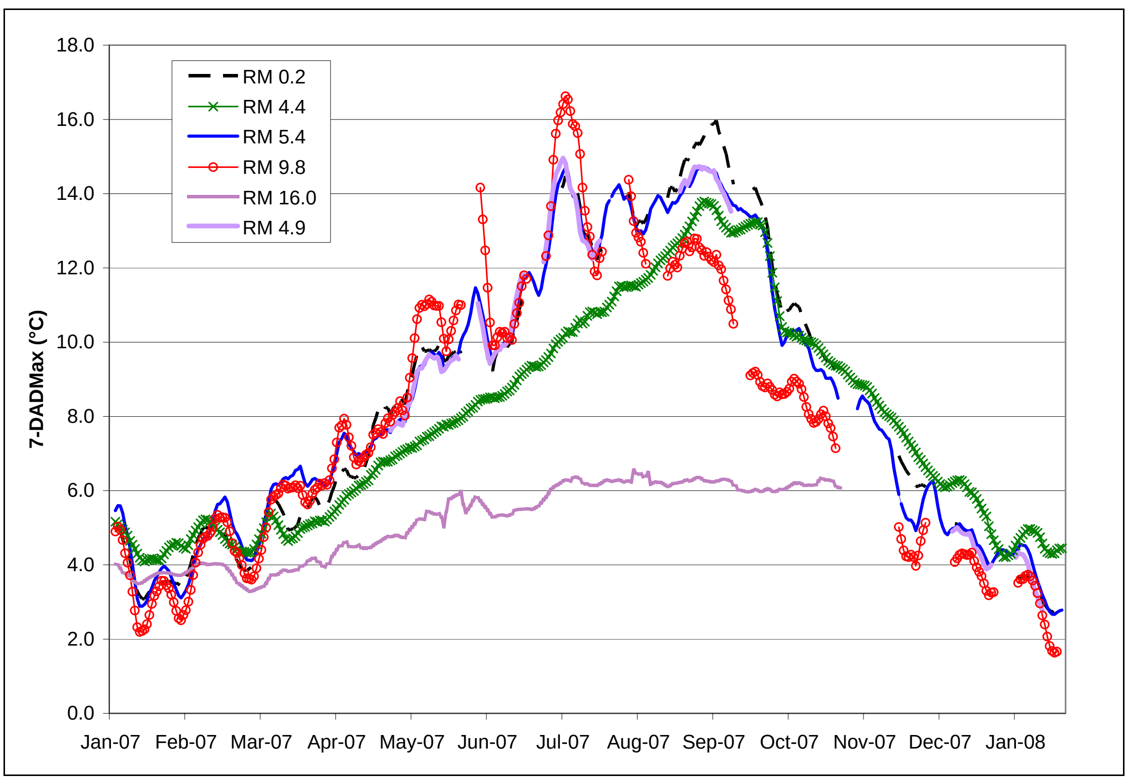


Figure E.6.2-8 7-DADMax temperatures (°C) in 2007 at Sultan River monitoring sites below Culmback Dam.

The data collected throughout the water quality study period indicate that maximum temperatures at the downstream Sultan River sites occurred in July and August, with the 7-DAD Max reaching to approximately 6°C at the Sultan River below Culmback Dam (RM 16), 16.6°C above the Diversion Dam (RM 9.8), 15°C above the Powerhouse (RM 5.4 and RM 4.9), 14.4°C below the Powerhouse (RM 4.4), and 16.1°C near the mouth (RM 0.2). The relatively cool maximum temperature of about 6°C below Culmback Dam (RM 16) is the result of cool low level releases from Culmback Dam during summer. As described above, Spada Lake is thermally stratified in August and September, and bottom temperatures in the lake average about 5 to 6°C. Further discussion of the effects of the relatively cool low level releases from Culmback Dam is provided in Section E.6.2.2.2.

Water temperatures at the downstream Sultan River sites generally meet state standards. During the 2-year water quality study, the 7-DAD Max water temperature values did not exceed (and therefore met or complied with) the designated criterion of 16°C at all times during the study at the downstream sites in the Sultan River below Culmback Dam (RM 16), above the Powerhouse (RM 5.4 and RM 4.9), and below the Powerhouse (RM 4.4). At the other two downstream sampling sites – above the Diversion Dam (RM 9.8) and near the mouth (RM 0.2) – less than 1 percent of the 7-DAD Max values exceeded the criterion, including a 5 day period in July 2007 at the site above the Diversion Dam (RM 9.8) when the 7-DAD Max reached 16.6ºC and 1 day in September 2007 at the site above the mouth (RM 0.2) when the 7-DAD Max reached 16.1ºC.

Dissolved Oxygen

During the water quality study, dissolved oxygen (DO) values upstream of the Project in the tributaries entering Spada Lake ranged between 8.7 and 13.2 milligram per liter (mg/L). Monthly or seasonal variation in DO values occurred, but trends were relatively consistent in comparison to the substantial changes in water temperature over the year. In 2007, DO in the tributaries entering Spada Lake generally was lowest in May and June, when values reached down to 8.7 to 9.2 mg/L, and highest in December, when values ranged from 12.5 to 13.0 mg/L. In 2008, DO generally was lowest in December, when values approached 9.6 mg/L, and highest in June, when values reached 12.7 to 13.2 mg/L. The daily (1-day) minimum values at the upstream tributary sites were above (and therefore met) the designated Core Summer Salmonid Habitat DO criterion of 9.5 mg/L, except for May and June 2007, when values reached down to 8.7 to 9.2 mg/L. As explained in Section E.6.2.2.2, these DO values less than the criterion appeared to be a result of unusually warm conditions combined with lower-than-normal flows at the time.

Profiles of DO in Spada Lake obtained during the water quality study were generally uniform in concentration with depth at values that ranged between about 8 and 13 mg/L (by month). However, instances of localized variations in DO with depth were evident, particularly in summer profiles. For example, the profiles obtained in August and September in both 2007 and 2008 showed localized increases in DO likely associated with primary production of phytoplankton near the surface, and localized reductions in DO likely associated with respiration of material entrained at the thermocline (Figure E.6.2-9). As discussed above, Spada Lake undergoes typical thermal stratification (resulting in the presence of a stable thermocline) during summer. Localized variations in DO with depth are common in lakes during summer (Welch 1992), even in oligotrophic lakes like Spada Lake that have low productivity (as discussed further below in "Nutrients"). The DO data obtained in Spada Lake for the entire 2-year Water Quality Parameter Study is discussed further in the Water Quality Final Technical Report (CH2M Hill 2009).

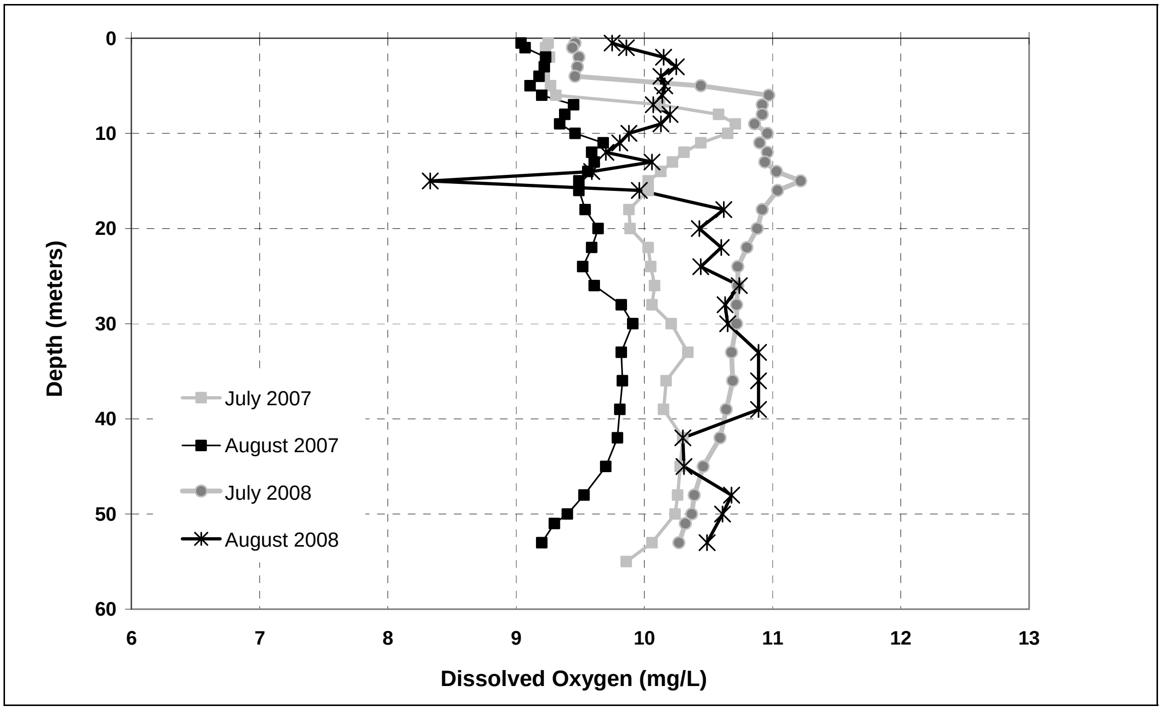


Figure E.6.2-9 Dissolved oxygen (DO) profiles in Spada Lake obtained in August and September of 2007 and 2008.

During the water quality study, DO values in the Sultan River downstream of Spada Lake (Culmback Dam) ranged between 8.1 and 14.9 mg/L. Monthly or seasonal variation in DO values occurred, but trends were relatively consistent in comparison to the substantial changes in water temperature over the year (as described above). DO values at the downstream Sultan River sites were lowest during June and July, and highest in December and January. At these downstream sites, 94 percent or more of DO values during the study were above (and therefore met or complied with) the Core Summer Salmonid Habitat DO criterion of 9.5 mg/L. Exceptions included a 3-week period in June 2007, when values were between 8.1 and 9.4 mg/L at each of the downstream sites. At the site near the mouth of the Sultan River (RM 0.2) exceptions also included an 8-day period in September 2007 and a 2 day period in October 2007, when values were between 9.1 and 9.4 mg/L. As described above, similar DO values occurred at tributary sites upstream of the Project area in June 2007, and were accompanied by warmer-than-usual temperatures and lower-than-normal flows in the watershed (as explained in Section E.6.2.2.2). On the days in September and October 2007 when the minimum DO values at RM 0.2 were less than 9.5 mg/L, the minimum DO values at other Sultan River sampling sites in closer proximity to the Project were all above 9.5 mg/L.

Turbidity

During periods of low stream flow, turbidity levels in tributaries to Spada Lake and the Sultan River generally remain low, but during and after intense rainstorms, turbidity levels may rise. Variable and dynamic turbidity is common in Washington State rivers and streams, which can carry high sediment loads in response to rainfall and snowmelt run-off events, and watershed erosion processes (Bash et al. 2001, Uhrich and Bragg 2003). Uhrich and Bragg (2003) indicate that, although baseflow turbidities can be quite low, it is not unusual to measure turbidities of 1,000 nephelometric turbidity units (NTUs) or greater during run-off events.

Available turbidity measurements in tributaries to Spada Lake upstream of the Project area include monthly and bi-weekly grab sampling results obtained during the 2-year water quality study as described in the Water Quality Final Technical Report (CH2M Hill 2009). Turbidity values at the upstream South Fork Sultan River (SF), North Fork Sultan River (NF), and Williamson Creek (WC) sites were less than 5 nephelometric turbidity units (NTU) in 95 percent (39 of 41) of the monthly and bi-weekly grab samples obtained during 2007 and 2008. Of these samples, the maximum turbidity was 11 NTU obtained at the Williamson Creek (WC) site in December 2007.

In Spada Lake, turbidity grab sample values obtained during 2007 and 2008 were less than 5 NTU in 86 percent (12 of 14) of samples taken near the surface of the lake (0–5 m depth), 100 percent (6 of 6) of samples taken near the lake's thermocline (6–16 m depth), and 71 percent (10 of 14) of samples taken above the lake bottom (42–52 m depth).[8] Turbidity was mostly less than 5 NTU with depth in all profiles taken during 2008 and in the summer of 2007. In other profiles taken during 2007, turbidity was more varied with depth, with higher turbidities observed at depth. Factors causing turbidity in Spada Lake, including higher turbidities at depth, are discussed further in Section E.6.2.2.2.

Turbidity values at downstream Sultan River sites above the Diversion Dam (RM 9.8), above the Powerhouse (RM 4.9), and near the mouth (RM 0.2) were less than 5 NTU in 77 percent, 92 percent, and 85 percent, respectively, of the monthly and bi-weekly grab samples obtained during the 2-year water quality study. In addition to the monthly and bi-weekly grab samples, hourly turbidity data was obtained from these sites using recording DataSondes®. The hourly data from the DataSondes® show that turbidity at these sites is dynamic and variable by season. Variation in turbidity generally corresponded to seasonal changes in precipitation and runoff conditions as discussed in the Water Quality Final Technical Report (CH2M Hill 2009). For example, during the fall months, increases in precipitation and flow conditions corresponded to contemporaneous increases in turbidity. Turbidities during winter months were consistently relatively low despite increases in precipitation, which likely was the result of precipitation accumulating mainly as snow at this time with relatively low turbidity-causing runoff. During summer months, variation in turbidity appeared to be "event-based", with episodic increases in turbidity occurring in response to occasional rainfall events and increased flows. Suspended algae material can sometimes affect turbidity

[8] For the water quality study, depths were recorded in meters. The equivalent depths in feet would be 0-16.4 feet; 19.7-52.5 feet; and 137.8-170.6 feet, respectively.

during summer in freshwater systems (Welch 1992), but is ruled out in this case as Spada Lake and the Sultan River are low in nutrients (i.e., oligotrophic) and resultant algal production.

Nutrients and Chlorophyll-a

During the 2-year water quality study, nutrients (consisting of six different nitrogen and phosphorus-based parameters) and chlorophyll-a values were consistently low in Spada Lake and at all river and tributary sites. The 2007 and 2008 nutrient and chlorophyll-a data are described in the Water Quality Final Technical Report (CH2M Hill 2009), and show results that are consistent with the historically available data for the Sultan River basin (Snohomish County PUD and City of Everett 2005).

During 2007 and 2008, the mean epilimnetic total phosphorus (TP) concentration in Spada Lake was 0.0083 mg/L based on six samples collected in the epilimnion[9] of the lake from July to September (an epilimnion was not developed in June for either year). This indicates that Spada Lake falls into the "oligotrophic" trophic state classification (for lakes with an epilimnetic TP of 0.004 to 0.010 mg/L) as set out in the state water quality standards (WAC 173-201A-230). A lake is usually classified as being in one of three possible trophic states: oligotrophic, mesotrophic or eutrophic. In general, oligotrophic lakes have low nutrients, low algal biomass, low algal productivity, and high water clarity (Welch 1992).

Another indicator of lake trophic status is the mean epilimnetic chlorophyll-a concentration during summer. Welch (1992) reports that mean epilimnetic chlorophyll-a concentrations during summer of less than 2.8 micrograms per liter (µg/L) are indicative of oligotrophic trophic state conditions. Even the highest values of chlorophyll-a obtained in Spada Lake – 2.7 µg/L during 2007 and 2.4 µg/L during 2008 – are less than the 2.8 µg/L threshold reported by Welch (1992). Therefore, the chlorophyll-a data also support characterizing Spada Lake as oligotrophic.

Hydrogen (ion) Concentration (pH) and Alkalinity

During the water quality study, most pH values obtained at the sampling sites were within (and therefore met or complied with) the designated Core Summer Salmonid Habitat pH criterion range of 6.5 to 8.5 (WAC 173 201A 200). Instances of pH outside this range occurred at all sites, including at tributary sites upstream of the Project area. When outside the range, pH values were consistently on the low (i.e., slightly acidic) side of the range. In addition, alkalinity values were consistently low at all sites throughout the study, indicating a low buffering capacity.

These results indicate that all sampling site – including tributary sites, Spada Lake, and the Sultan River downstream of Spada Lake – are similarly circumneutral to slightly acidic with low buffering capacity. Such conditions are known to occur in western Cascades streams. Hayslip et al. (2004) report that the pH of the western Cascades

[9] The epilimnion is the top-most layer above the thermocline (and deeper hypolimnion) in a lake that has become thermally stratified.

ecoregion sites ranged from 5.5 to 8.1 with a mean of 7.1. Slightly acidic rainfall occurs in the western Cascades and alkalinity (the capacity of the solutes of water to react with and neutralize acid) is generally low (Welch et al. 1998).

The pH measurements at the upstream South Fork Sultan River (SF), North Fork Sultan River (NF), and Williamson Creek (WC) sites were within the range of 6.5 to 8.5 in 67 percent, 64 percent, and 75 percent, respectively, of the grab samples taken during the two-year study. All excursions of pH values outside the criterion range of 6.5 to 8.5 at the upstream sites occurred between April and July, and mostly consisted of values of 6.0 to 6.4. Total alkalinity at the upstream sites was measured at 16.7 mg/L or less (as calcium carbonate, CaCO3) during the 2-year study, indicating that the tributaries above Spada Lake have very low buffering effect on pH. Total alkalinity levels of 20 to 200 mg/L (as CaCO3) are typical of freshwater (Hem 1970).

In Spada Lake, pH and alkalinity values in the lake reflected the magnitude and range of values at the upstream tributary sites. During 2007 and 2008, the average pH in Spada Lake was 6.4, with a range in recorded pH values of 5.3 to 7.2. Alkalinity values in Spada Lake generally were within the range of 5.5 to 9.5 mg CaCO3/L. The pH profiles in Spada Lake taken during the 2-year study generally were uniform with depth during months when the lake was not thermally stratified. During periods of stratification, the profiles showed more noticeable gradually-declining gradients of pH with depth. The gradual vertical gradients of pH in the lake likely reflect subtle effects on pH from phytoplankton primary production near the surface and respiration near the bottom.

The pH values at the Sultan River above the Diversion Dam (RM 9.8) were within the criterion range of 6.5 to 8.5 in 94 percent of grab samples and in 99 percent of hourly DataSonde® measurements during the study. The minimum grab sample pH and minimum hourly pH reading were both 6.4. Total alkalinity at the Sultan River above the Diversion Dam (RM 9.8) was measured at 11 to 14 mg/L or less (as CaCO3) during the 2-year study. The alkalinity levels were consistently slightly higher than in the upstream tributary sites and Spada Lake, which may help explain the slightly higher pH values above the Diversion Dam (RM 9.8).

The pH and total alkalinity values and trends at the Sultan River above the Powerhouse (RM 4.9) were very similar to those obtained above the Diversion Dam (RM 9.8). The pH values at the Sultan River above the Powerhouse (RM 4.9) were within the criterion range of 6.5 to 8.5 in 94 percent of grab samples and in 97 percent of hourly DataSonde® measurements during the 2-year study. The minimum grab sample pH was 6.3 and minimum hourly pH reading was 6.2.

The pH and total alkalinity values and trends at the Sultan River above the mouth (RM 0.2) were very similar to those obtained at the upstream Sultan River sites. The pH values at the Sultan River above the mouth (RM 0.2) were within the criterion range of 6.5 to 8.5 in 82 percent of grab samples and in 88 percent of hourly DataSonde® measurements during the two-year study. The minimum grab sample pH was 6.2 and minimum hourly pH reading was 6.2. As with the other sites, the data indicate that conditions above the mouth (RM 0.2) are circumneutral to slightly acidic with very low buffering capacity.

Fecal Coliform Bacteria

During the water quality study, fecal coliform bacterial levels were either not detected or generally low at all sites. Fecal coliform at the three tributary sites upstream of the Project area (WC, NF, and SF) were detected in 40 percent of samples taken in 2007 and 2008. Of samples with detections, the highest values were 6 colony-forming units (CFU)/100 milliliters (ml) in 2007 and 202 CFU/100 ml in 2008 – both at the WC site. Fecal coliform in Spada Lake were not detected during any of the sampling events in 2007 and 2008, except in one instance, when a low value of 6 CFU/100 ml was detected.

Fecal coliform at the three Sultan River sampling sites downstream of Culmback Dam (RM 9.8, RM 4.9, and RM 0.2) were detected in 85 percent of samples taken in 2007 and 2008. Of samples with detections, the highest values were 42 CFU/100 ml in 2007 at RM 9.8, and 26 CFU/100 ml in 2008 at the RM 4.9 and RM 0.2 sites.

Compliance with the designated water quality standard for fecal coliform is determined based on the geometric mean of the detected values. At all sites, the geometric means of the detected values were less than (and therefore met and complied with) the state standard of 50 CFU/100 ml.

Total Dissolved Gas

Total dissolved gas (TDG) measurements were made during the water quality study in the Sultan River below the Powerhouse (tailrace) at RM 4.4. This site was chosen to determine whether TDG supersaturation (i.e., TDG saturation greater than 110 percent) from potential turbine air entrainment is of concern. Although air entrainment through turbines can lead to gas supersaturation, the situation is not common and increased gas pressure from this air entrainment is usually not substantial (Ecology 2004).

TDG measurements were made during monthly sampling events at RM 4.4. During 2007, TDG measurements ranged between 86 and 104 percent saturation, and averaged 99 percent saturation. During 2008, TDG measurements ranged between 84 and 106 percent saturation, and averaged 97 percent saturation. These TDG values were less than (and therefore met or complied with) the designated state criterion of 110 percent (WAC 173 201A-200).

TDG also was measured on a continuous hourly basis for 1 week during summer baseflow conditions in June 2008 and 1 week during maximum generation conditions in July 2008. TDG during the June 2008 event (summer baseflow) ranged between 102.7 and 103.9 percent saturation. TDG during the July 2008 event (maximum generation) ranged between 101.5 and 103.1 percent saturation. All TDG values measured during both sampling events were below the state criterion level of 110 percent saturation and therefore met the water quality standard.

Other Parameters

As with the parameters presented above, the results obtained during the 2-year water quality study for other parameters also indicate very good water quality. Conductivity and total dissolved solids (TDS) data obtained at all sites during the study indicate dilute dissolved solids and ions content.

Total petroleum hydrocarbons (TPH) were not detected in 52 of the 53 samples obtained during the study at Sultan River sites RM 16, RM 9.6, and RM 4.4. One sample obtained during the June 2008 sampling event had a TPH concentration of 0.10 mg/L. It is uncertain why TPH was detected in this one sample. However, the reported concentration was low (at the analytical reporting limit) and the corresponding field duplicate sample was non-detectable.

E.6.2.2 Project Effects

E.6.2.2.1 Water Quantity

Project operations involve the storage of water which inherently affects seasonal water quantity downstream of Culmback Dam. Effects on water quantity from storing water and metering releases from the dam to generate power can be categorized as (1) flow alterations and (2) flow fluctuations. Project effects on pre-Project Sultan River flows are summarized under these two categories below.

E.6.2.2.1.1 Flow Alterations

Flow alterations generally refer to major changes in the unregulated yearly hydrograph over long periods (weeks or months), such as reduction of the total quantity of water delivered to the stream channel through water diversion, or changes in flow derived from seasonal storage for water supply, flood control and hydropower production. The following is a summary of flow alterations derived from Stage II Project operations; Stage I flows are considered "pre-Project" for this comparison. Satisfying the pre-existing right for City of Everett municipal water withdrawals is a requirement of hydroelectric Project operations, but is not considered a Project effect in this analysis.

Seasonal storage of water in Spada Lake has altered flow downstream of Culmback Dam. Although the mean annual discharge for the Sultan River basin is essentially the same when comparing Stage II to Stage I, current operations alter seasonal runoff attributes. In general, summer flows are higher, and peak flows in fall and winter are lower, but are longer in duration. To further quantify Project effects during relicensing, the effects of existing Project operations on flow conditions in the Sultan River downstream of Culmback Dam were evaluated using an IHA/RVA study as summarized below.

Indicators of Hydrologic Alteration

IHA/RVA are components of an analytical software package typically used to characterize and compare complex river reach or river basin-scale hydrologic regimes from two or more periods of time. The program assesses and summarizes 67 hydrology statistics derived from daily hydrologic data (e.g., magnitude of monthly flows, timing of annual extreme water conditions, frequency and duration of high and low pulses). The results of an IHA/RVA analysis can then be used to illustrate the effects of Project operations on the pre-Project flow regime.

The District's IHA/RVA study compared the effects of existing Project operations (July 1, 1984 to June 30, 2004) with those occurring prior to the implementation of Stage II (i.e. pre-July 1, 1984) (R2 Resource Consultants 2008a). Three operational reaches were examined in the study: Reach OR-1, OR-2, and OR-3 (as previously defined and shown in Figure E.6.2-2). The IHA/RVA assessments were performed at the upstream and downstream ends of each study reach. A brief summary of the IHA/RVA results for Reaches 1 through 3 of the Sultan River follows. These results are considered the "effect" of Project operations on Sultan River seasonal flows. The following summary is not meant to cover all of the 67 statistics generated from IHA/RVA, but rather summarizes several important physical and biological parameters discussed in subsequent resource sections.

OR-1 (Powerhouse to the confluence with the Skykomish River)

- Average monthly flows were increased by the Project in July, August, September, December, and February, and were decreased by the Project in October, November, January, March, April, May, and June.
- The magnitudes of annual minimum stream flows were increased and the magnitudes of annual maximum flows were decreased by the Project.
- The frequency of high flow pulses has decreased and the duration of high flow pulses has increased as a result of Project operations.
- The occurrence of extreme low flows has been eliminated by the Project.
- The recurrence interval of small magnitude floods (11,200 to 17,700 cfs) has extended from 2 years to about 20 years and the recurrence interval of large magnitude floods (greater than 17,700 cfs) has extended from 10 years to about 20 years.

OR-2 (Diversion Dam to the Powerhouse)

- Average monthly flows were increased by the Project in August and September, and were decreased by the Project from October through July.
- The magnitudes of annual minimum stream flows were increased and the magnitudes of annual maximum flows were decreased by the Project.
- The frequency and duration of high flow pulses have both decreased in OR-2 as a result of Project operations.
- The occurrence of extreme low flows has been eliminated by the Project.
- The recurrence interval of small magnitude floods (10,300 to 16,600 cfs) has extended from 2 years to about 20 years and the recurrence interval of large

magnitude floods (greater than 16,600 cfs) has extended from 10 years to about 20 years.

OR-3 (Culmback Dam to the Diversion Dam)

- Average monthly flows were decreased in OR-3 by the Project for all 12 months of the year.
- The magnitudes of annual minimum stream flows and annual maximums were both decreased in OR-3 by the Project.
- The frequency and duration of high flow pulses have both been decreased in OR-3 as a result of Project operations.
- The median magnitude of extreme low flows has been reduced in OR-3 by the Project.
- The recurrence interval of small magnitude floods (9,100 to 15,500 cfs) has extended from 2 years to about 20 years and the recurrence interval of large magnitude floods (greater than 15,500 cfs) has extended from 10 years to about 20 years.

Reservoir Fluctuations

No specific numerical calculations were conducted to compare the frequency or magnitude of Spada Lake water level fluctuations under Stage I or Stage II operations. However, the height of Culmback Dam was raised by 62 feet as part of Stage II development which increased the storage capacity by 4.5 times, and thus the reservoir level at full pool is higher under existing conditions when compared to Stage I. Therefore, the reservoir can and does fluctuate in magnitude to a greater degree under Stage II. Frequency of fluctuation was not assessed, but overall seasonal fluctuations may be similar between Stage I and Stage II because seasonal inflow patterns are similar. General fall drawdown strategies provided some flood storage under Stage I and have been increased under Stage II operations to provide additional incidental flood management by reducing the frequency and magnitude of spill events.

Minimum Stream Flow Compliance

The District is required to monitor minimum stream flow compliance with continuous gaging. All minimum stream flow excursions must be reported to FERC and the Joint Agencies. The District must also determine the cause of each excursion and report any actions taken to correct or avoid recurrences. Compliance of minimum stream flows below the Diversion Dam is determined by measurement at the USGS real-time Gaging Station No. 12137800 at Sultan RM 9.6 (http://waterdata.usgs.gov/wa/nwis/uv?12137800). Minimum stream flow compliance below the Powerhouse is determined by measurement at the USGS real-time Gaging Station No. 12138160 at Sultan RM 4.4 (http://waterdata.usgs.gov/wa/nwis/uv?12138160).

Of the 41 incidents reported since 1988, 31 occurred at the Diversion Dam and 19 incidents were considered by FERC to constitute violations of the minimum stream flow standards. Ten of these incidents occurred in 1990 and were associated with an alarm-setting problem that caused only minor deviations below the required minimum stream flow.

Of the 19 violations at the Diversion Dam, 15 averaged within 2 percent of the minimum stream flow requirement. The most significant incident (in terms of deviation from the required minimum stream flow below the Diversion Dam) occurred on October 30, 1988 and lasted for 45 minutes; the minimum stream flow requirement was 155 cfs, but the recorded flow was 23 cfs. The cause of this violation was listed as "human scheduling error". Due to tributary and bank inflows, the relatively short duration of the incident, and attenuation of impacts with distance downstream from the Powerhouse, this incident was determined not to have any significant impact to fish. Most other incidents occurred because of equipment failure. Excluding the 10 alarm-setting incidents in 1990, the Diversion Dam has had about one minimum stream flow compliance violation per year from 1988 to 1993, typically lasting for only a few minutes. Only one lasted for more than an hour (75 minutes, 18 cfs variance, 19 percent deviation from the minimum stream flow requirement). The last violation at the Diversion Dam was on March 1, 1993.

Only one incident was considered a violation at the Powerhouse. It occurred on July 18, 1994 and lasted about 6 minutes. This incident consisted of an approximately 6.5 percent deviation from the minimum stream flow standard.

In 2002, the District installed hardware and software to allow automated control of the flows to the Diversion Dam. This gave the District a closed loop control system for automatically responding to Sultan River flow changes that could fall below the Project license requirements. It replaced the original system of preset alarms that notified District staff when river flows were near or below the license requirements. District staff responding to the alarm would manually adjust the Portal 2 sluice gate to divert more flow to the Diversion Dam. With the automated system, the need for a human response was eliminated and only three minor minimum stream flow incidents at the Diversion Dam have occurred since system installation, none of which were considered violations of the license by the FERC.

E.6.2.2.1.2 Flow Fluctuations

Ramping Compliance

Because the Project is not operated as a power "peaking" facility, downramping events are not frequent or rapid compared to those at most hydroelectric peaking projects. Flow changes at the Powerhouse are driven primarily by changing hydrologic conditions and the need to maintain the Spada Lake level within prescribed elevation limits.

The greatest risk of sudden Project-induced downramping events in the lower Sultan River occurs during unplanned and unforeseen events that force the Powerhouse to shut down rapidly. The two most common reasons for these events have been equipment failures and lightning storms. Several equipment modifications have been made to address these shortcomings. To address concerns regarding forced outages during lightning storms, the District now requires that operators be present at the Powerhouse during certain forecasted electrical storm conditions to help prevent outages or to restore flow to the river quickly following such events. In addition, the Project makes use of the "Jackson Loop" which provides redundant transmission lines leading from the Powerhouse to the Snohomish substation. This system allows the Powerhouse to continue operating during a fault outage on either the east or west segment of the Loop. Until several years ago this redundant transmission line system had not always worked as intended; however, upgrades to the equipment and its calibration have now demonstrated that the system can perform satisfactorily. The North Loop was not included in the Project boundary and removal of the South Loop as a Project facility was approved by FERC on May 3, 2006.

As with minimum stream flow compliance, the District continuously monitors downramping rates (at the same USGS gaging locations as listed for minimum stream flow compliance) and reports all possible excursions to FERC and the Joint Agencies. Since May 1988, 45 downramping incidents have occurred, but only two were considered violations of FERC license requirements. Most of the incidents were the result of equipment failures that caused immediate generation reductions at the Powerhouse. Most incidents (27 of 35) lasted 15 minutes or less with an average decline in stage of approximately 5 inches. The most substantial incident (in terms of total stage decrease and rapid stage decline) occurred on December 31, 1990, when the stage declined a total of 22.5 inches in 6 minutes (the applicable downramping limit is a maximum of 4 inches per hour). The last incident deemed a violation by FERC occurred in 1994. The effects of ramping on aquatic resources, such as fish, are presented in Section E.6.3.2.

Winter Steelhead Fishery Recreational Flow Downramping Frequency

As described in Section E.6.2.1.1.2, the District reduces flows for 36 hours on a weekend under certain conditions to enhance recreational winter steelhead fishing opportunities. The District has exercised the flow reduction program for winter steelhead fishing once per year in 10 of the past 18 years.

E.6.2.2.2 Water Quality

This section provides an assessment of the compliance of water quality conditions in the Project vicinity with State water quality standards and the potential causes for effects on water quality, including effects with a nexus to Project facilities and operations.

E.6.2.2.2.1 Water Temperature

As described above in Section E.6.2.1.2.2, water temperature conditions throughout the 2-year water quality study were less than (and therefore met) the designated Core Summer Salmonid Habitat temperature criterion of 16°C at all locations at nearly all times. The times and locations when the criterion of 16°C was exceeded occurred for 5 days in July 2007 (to 16.6°C) in the Sultan River above the Diversion Dam (RM 9.8), and for 1 day in September 2007 (to 16.1°C) near the mouth (RM 0.2). Otherwise, water temperatures at these two sites were less than (and therefore met) the designated 16°C criterion on 99.1 and 99.8 percent of days, respectively, during the 2-year study.

Figure E.6.2-9 shows 7-DAD Max values during 2007 above Spada Lake at Williamson Creek (WC), and in the Sultan River below Culmback Dam (RM 16), above the Diversion Dam (RM 9.8), and near the mouth (RM 0.2). Figure E.6.2-9 also shows corresponding 2007 data for water level elevation at Spada Lake (feet), and mean daily streamflow in the Sultan River from USGS gaging stations below the Diversion Dam and below the Powerhouse. These results indicate that water temperatures vary longitudinally through the Project area, in part related to Project control of water temperatures at the Diversion Dam and releases of relatively cool water below Culmback Dam when Spada Lake is thermally stratified (from approximately May through October).

Project Control of Water Temperatures at the Diversion Dam

Figure E.6.2-10 indicates that there can be times when the 7-DAD Max temperatures in the Sultan River in the Project area during summer are cooler than the 7-DAD Max temperatures in the tributaries upstream of Spada Lake. This cooling reflects the beneficial effect of the water intake control structure in Spada Lake (adjacent to Culmback Dam) that is used to control the temperature of water withdrawn to the Jackson Powerhouse and discharged to the river at the Diversion Dam. The water intake control structure in Spada Lake began operation in 1984 when Stage II of Project construction was completed. The Powerhouse intake flows are routed through the turbine units at the Powerhouse, then through the Lake Chaplain pipeline to a control structure (Portal 2), where flows are diverted through the diversion tunnel, and are discharged to the Sultan River at the Diversion Dam.

The existing FERC license specifies that water temperatures (measured at the Diversion Dam) be maintained within the recorded daily minimum-maximum range and, to the fullest extent possible, approximate Stage I mean daily temperatures. The requirements for water temperature control were established on the basis of a Settlement Agreement with the Joint Agencies. The historical graph of approximate Stage I mean daily temperatures at the Diversion Dam as specified in the Settlement Agreement was developed from water temperature data collected from 1969 to 1979 (prior to Stage II construction).

Control of water temperature using the water intake control structure is feasible when Spada Lake is thermally stratified (from approximately May through October). During the stratification period, moveable panels on the water intake control structure are used to control the level and, hence, the temperature at which water is withdrawn from the lake to the Powerhouse intake. The degree of temperature control possible by panel manipulation varies seasonally with the degree of temperature stratification in the lake. During isothermal conditions in the reservoir (i.e., when water temperature does not vary with depth; usually November through March), changes in water temperature cannot be achieved through moving the intake structure panels.

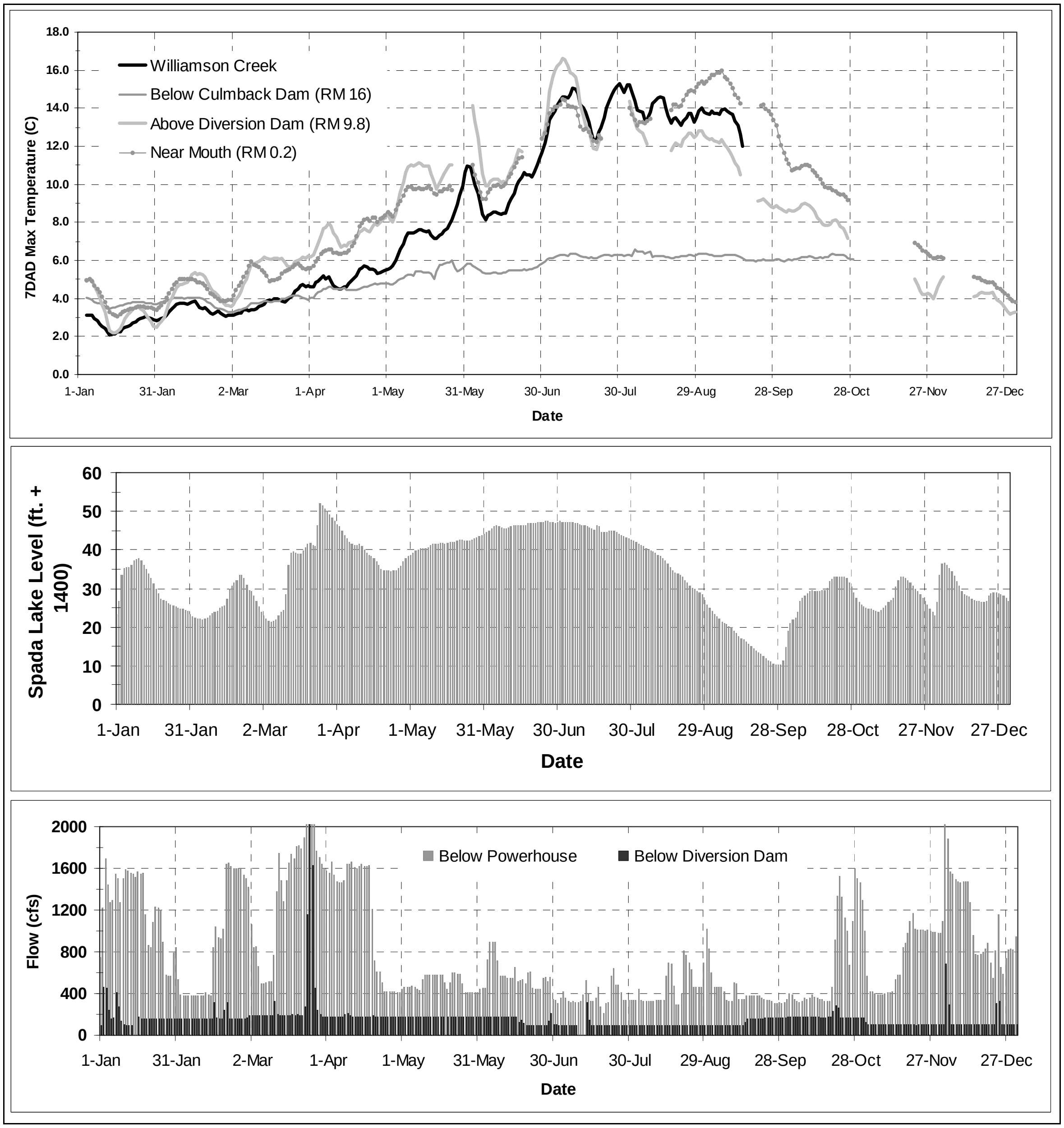


Figure E.6.2-10 7-DAD Max water temperatures (in ºC) during 2007 for Williamson Creek and the Sultan River at RM 16, RM 9.8, and RM 0.2, and corresponding data for water level elevation at Spada Lake (feet +1400), and mean daily streamflow in the Sultan below the Diversion Dam (USGS Gaging Station 12137800) and below the Powerhouse (USGS Gaging Station 12138160).

Figure E.6.2-11 shows the average of maximum daily water temperatures (in ºC) for the Sultan River just below the Diversion Dam (RM 9.6) based on available data from 1969 to 1980 (following Stage I construction and prior to Stage II construction) and 1984 to 2006 (since Stage II operations began). These results indicate that maximum water temperatures have been consistently cooler under Stage II operations compared to Stage I operations, especially during the summer. The consistently cooler daily maximum temperatures demonstrate the beneficial effects of the water intake control structure.

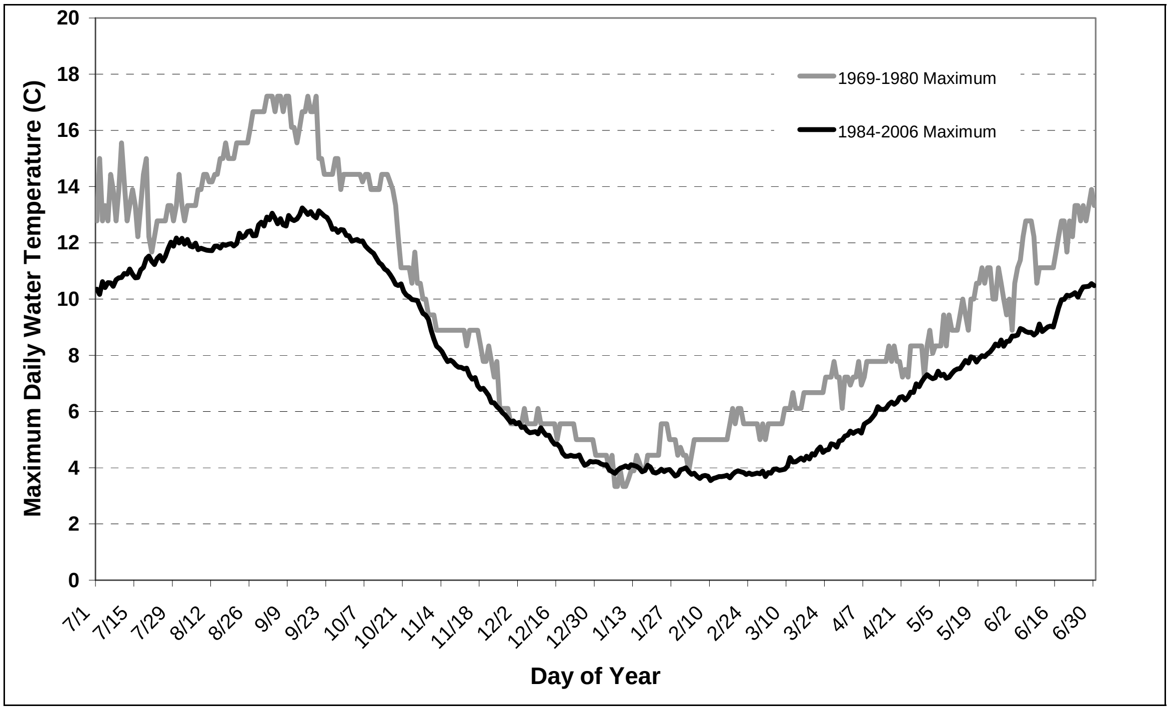


Figure E.6.2-11 Average of maximum daily water temperatures (in ºC) for the Sultan River below the Diversion Dam (RM 9.6) from 1969 to 1980 (following Stage I construction and prior to Stage II construction) and 1984 to 2006 (since Stage II operations began).

Releases of Cool Water to the Bypass Reach from Culmback Dam

Figure E.6.2-10 shows that 7-DAD Max water temperature values at the depicted sites during 2007 were consistently less than the designated Core Summer Salmonid Habitat criterion of 16°C. The exception occurred at the site above the Diversion Dam (RM 9.8), where 7-DAD Max water temperature values exceeded 16°C for a 5-day period from July 5 to July 10 with a maximum of 16.6°C on July 8. During 2008, no such exceedence was observed above the Diversion Dam (RM 9.8), similar to all other sampling sites.

As described above in Section E.6.2.1.2.2, relatively cold water is released from Culmback Dam at RM 16 during summer (i.e., about 5 to 6°C) to the reach from the dam to the Diversion Dam (as indicated by the consistently lower plot line for RM 16 in Figure E.6.2-10). This relatively cold water originates from the deeper portion of Spada

Lake, where cold water is stored, including through the summer (as seen in Figure E.6.2-6). Once released to this reach, the cold water temperatures are warmed relatively quickly as the water flows to the downstream end of the reach (as indicated by the consistently higher plot line for the site above the Diversion Dam at RM 9.8 in Figure E.6.2-10). The water temperature at the site above the Diversion Dam thus increases towards a temperature level that is more equilibrated to local summer meteorological conditions, and more closely resembles the temperature trends observed at upstream sites above Spada Lake (e.g., Williamson Creek). Example water temperature linear profiles from July and September 2007 illustrate this effect (Figure E.6.2-12).

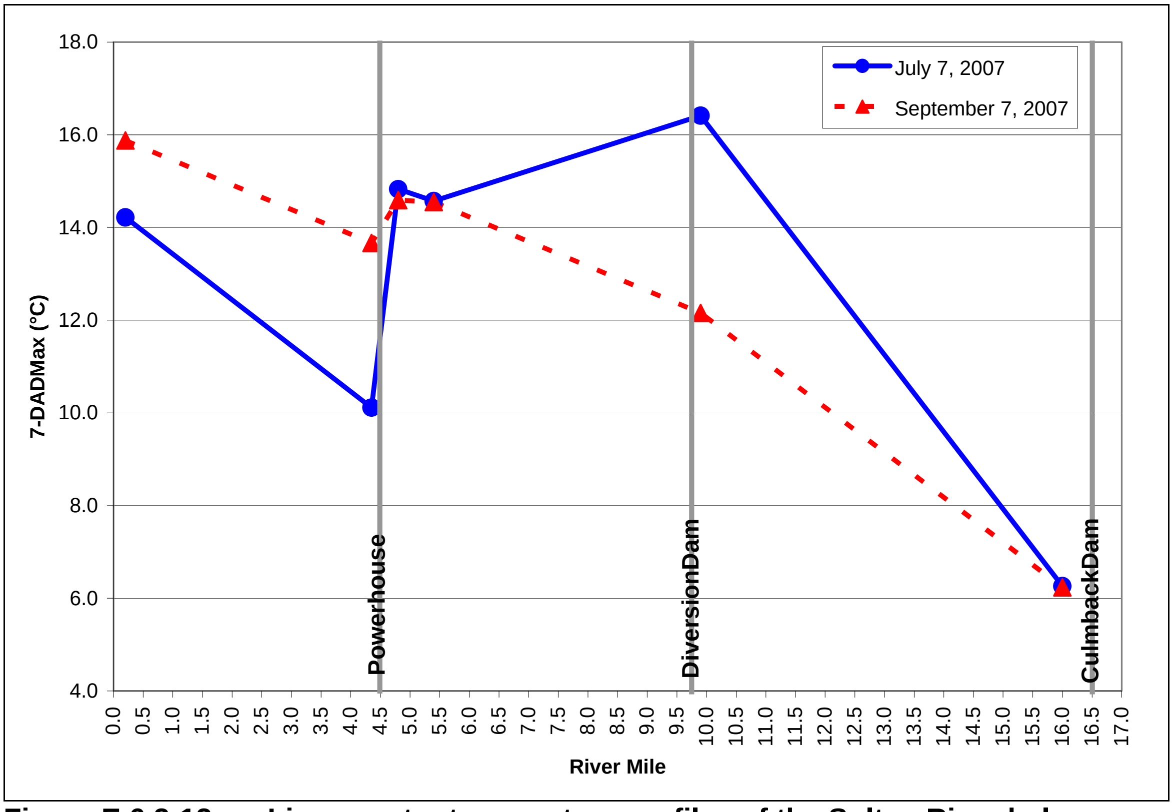


Figure E.6.2-12 Linear water temperature profiles of the Sultan River below Culmback Dam on July 7 and September 7, 2007 (based on data collected at six monitoring locations).

Figure E.6.2-12[10] indicates that the water in the bypass reach, which starts out relatively cold, warms at a faster rate longitudinally than water released at the Diversion Dam and Powerhouse. This faster rate of warming likely results from both the much lower starting temperature and lower discharge (i.e., 20 cfs) of water released to the bypass reach (i.e., air temperature has a greater warming effect as water volume decreases). Additional

[10] Note that Figure E6.2-12 is a simplification of the water temperature profile in the lower Sultan River on particular days and is based on six monitoring locations. One would expect additional warming/cooling events to occur at tributary junctions where additional flow of various water temperatures mixes with the mainstem Sultan River flow. Water temperatures may also change in locations with hyporheic exchange and may be influenced by reach variations in riparian vegetation, aspect and valley form (influences on the amount of solar radiation reaching the channel).

factors that may contribute to the faster rate of warming in the bypass reach is the decreased tributary inflow during summer dry periods, and the probable lack of hyporheic exchange due to the large expanse of bedrock substrate in the reach. This may explain why the highest water temperatures within the lower Sultan River observed during the 2-year water quality study were recorded at the lower end of the bypass reach above the Diversion Dam (RM 9.8), even though the lowest water temperatures recorded in the summer were at the upstream end of the bypass reach below Culmback Dam (RM 16.0).

As part of Project relicensing studies, the District conducted an instream flow study in the Sultan River between Culmback Dam and the Diversion Dam (OR-3) to evaluate the effects of different flow release scenarios on water temperature and physical habitat area. As a result of this instream flow analysis and discussions with stakeholders, a PM&E measure titled "Water Temperature Conditioning in Operational OR-3" is proposed to condition temperatures of water released at Culmback Dam pursuant to proposed instantaneous minimum stream flow requirements. The objective of this PM&E measure is to provide a seasonally appropriate water temperature regime to improve conditions for aquatic resources (including resident fish and macroinvertebrates) and maintain compliance with the WQ standards in OR-3. This PM&E measure is discussed further in Section E.6.2.3.3.

E.6.2.2.2.2 Dissolved Oxygen

As described above in Section E.6.2.1.2.2, DO conditions throughout the 2-year water quality study were greater than (and therefore met) the designated Core Summer Salmonid Habitat DO criterion of 9.5 mg/L at all locations at nearly all times. The primary exception occurred during June 2007, when DO was less than the criterion at all locations. For example, a plot of DO before, during, and after the June 2007 period is shown in Figure E.6.2-13 for six of the sampling sites, including the three sites upstream of the Project area. Given that exceptions occurred both upstream and downstream of the Project area, it does not appear to be a Project effect.

Changes in DO levels in freshwater systems occur mostly by changes in water temperature (which is a factor in the solubility of oxygen in water), flow (which provides turbulence and physical re-aeration), algae production and respiration, or oxygen demand from organic matter in suspension or in sediments (Welch 1992). The Water Quality Final Technical Report (CH2M Hill 2009) contains an analysis comparing minimum daily DO values in the Sultan River above the Powerhouse (RM 4.9) during the June 2007 period with concurrent maximum daily water temperature, turbidity, and mean daily flow for the Sultan River, along with maximum daily air temperature recorded in the area.

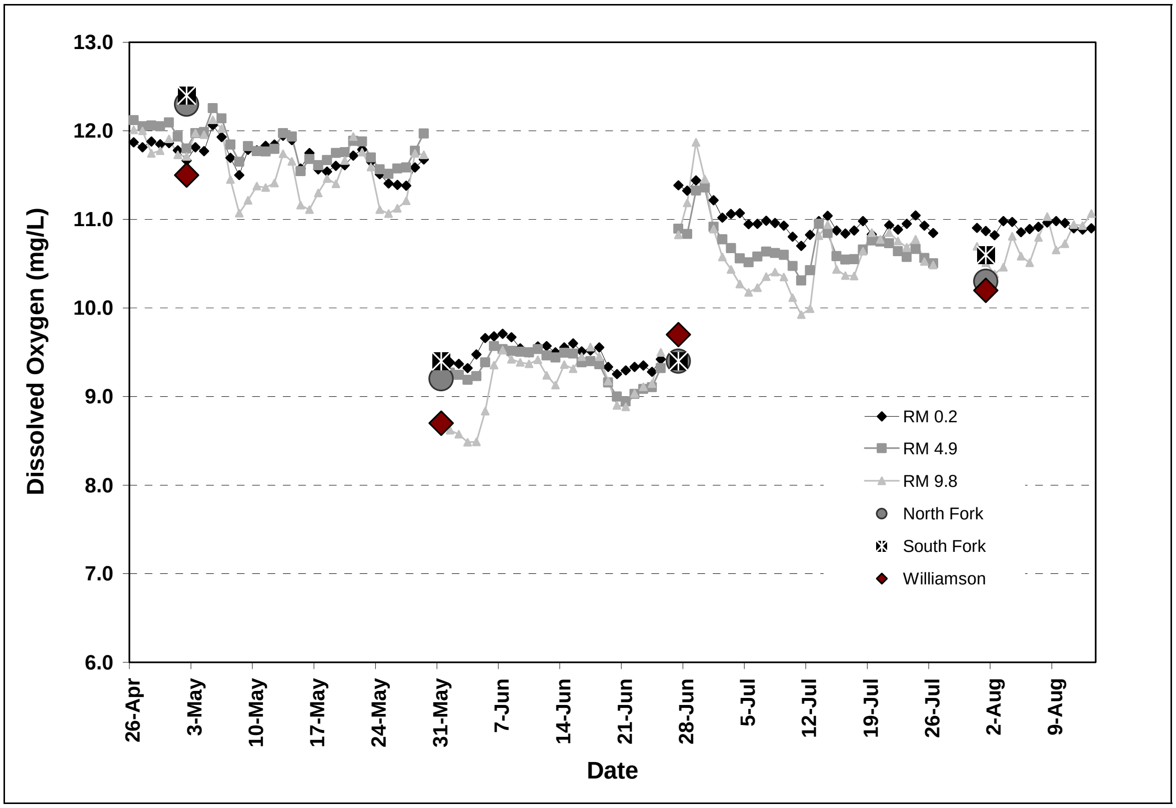


Figure E.6.2-13 Mean daily DO (in mg/L) in the Sultan River near the mouth (RM 0.2), above the Powerhouse (RM 4.9), and above the Diversion Dam (RM 9.8), and concurrent DO in grab samples taken at the North Fork, South Fork, and Williamson Creek sites, April 26 to August 13, 2007.

The results of this analysis suggests that DO during the June 2007 period was affected by unusually warm air temperatures combined with lower-than-normal flows, which may have contributed to reduced solubility of oxygen (at saturation) during this period. Algae production and respiration is likely not a factor in the observed changes in DO due to the oligotrophic nature of waters in the upstream tributaries, Spada Lake, and the Sultan River in the Project area (as supported by nutrient and chlorophyll-a data discussed above in Section E.6.2.1.2.2). Turbidity remained relatively low, particularly during the portion of this period when DO conditions changed, indicating that potential changes in suspended matter were probably not a factor in the observed DO effects.

E.6.2.2.2.3 Temperature and DO in Spada Lake Related to Fish Habitat Use

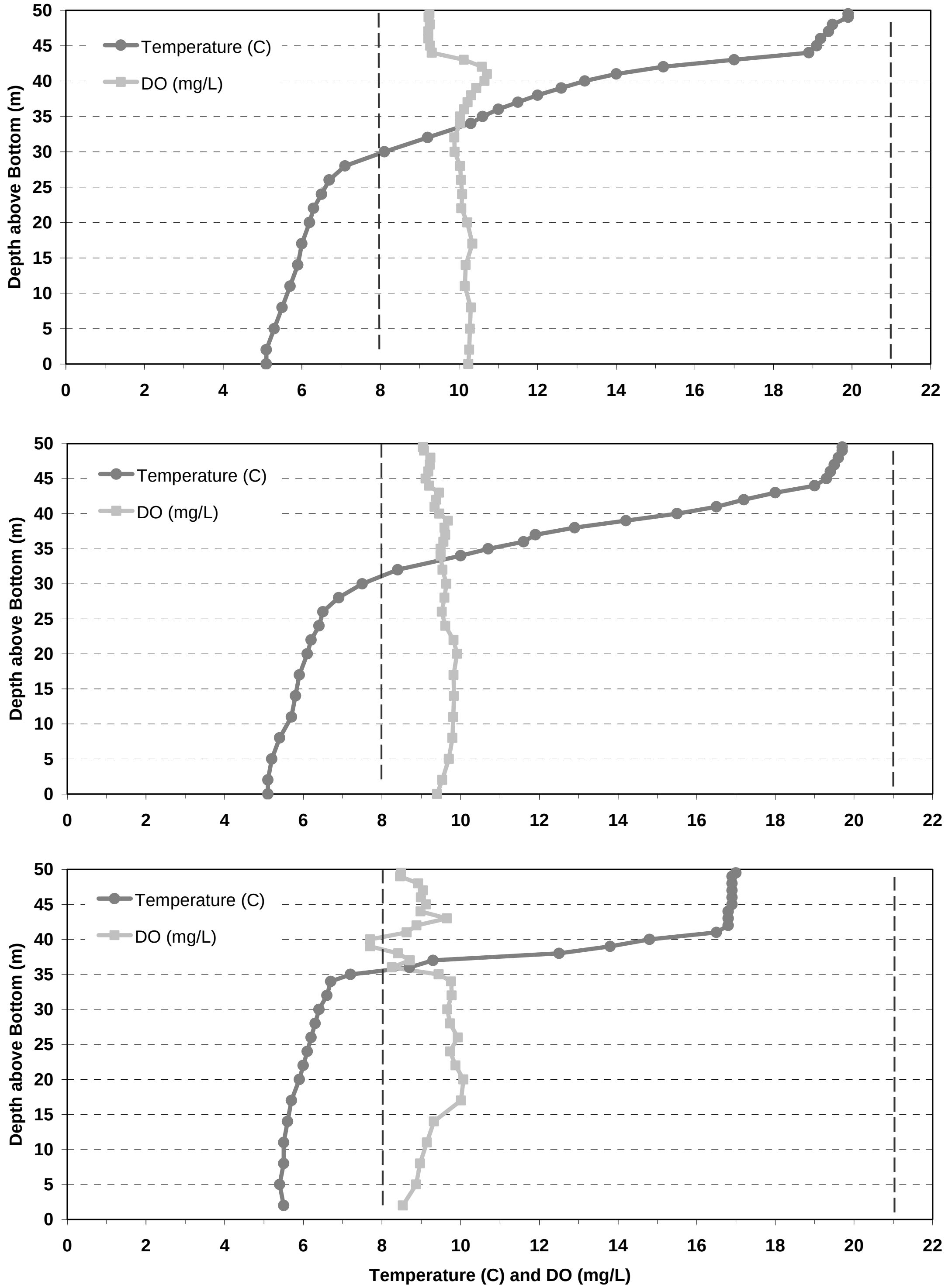
Water temperature and DO conditions in Spada Lake during the 2-year water quality study were assessed to determine whether suitable conditions are maintained in the lake to support the aquatic life beneficial use (i.e., habitat for trout), particularly in the summer months. This direct assessment of beneficial use protection was performed rather than an assessment based on the water temperature and DO standards for a lake (as defined under WAC-173-201A-020) due to the lack of actual empirical data on “natural conditions” that are needed for evaluations using the lake standards. Vertical profiles of water temperature and DO in the lake for the months of July, August, and September were evaluated to determine whether suitable water quality is maintained to support the aquatic life beneficial use (e.g., is available fish habitat squeezed between temperatures that are too high and DO conditions that are too low?). During the other months of the year, thermal stratification of the lake does not occur, and such a potential habitat "squeeze" is not a concern.

Figures E.6.2-14 and E.6.2-15 show vertical profiles of water temperature and DO in Spada Lake during July, August, and September of 2007 and 2008, respectively. The temperature profiles show the thermal stratification that routinely occurs in Spada Lake during the summer months. By comparison, vertical stratification of DO is not as evident.

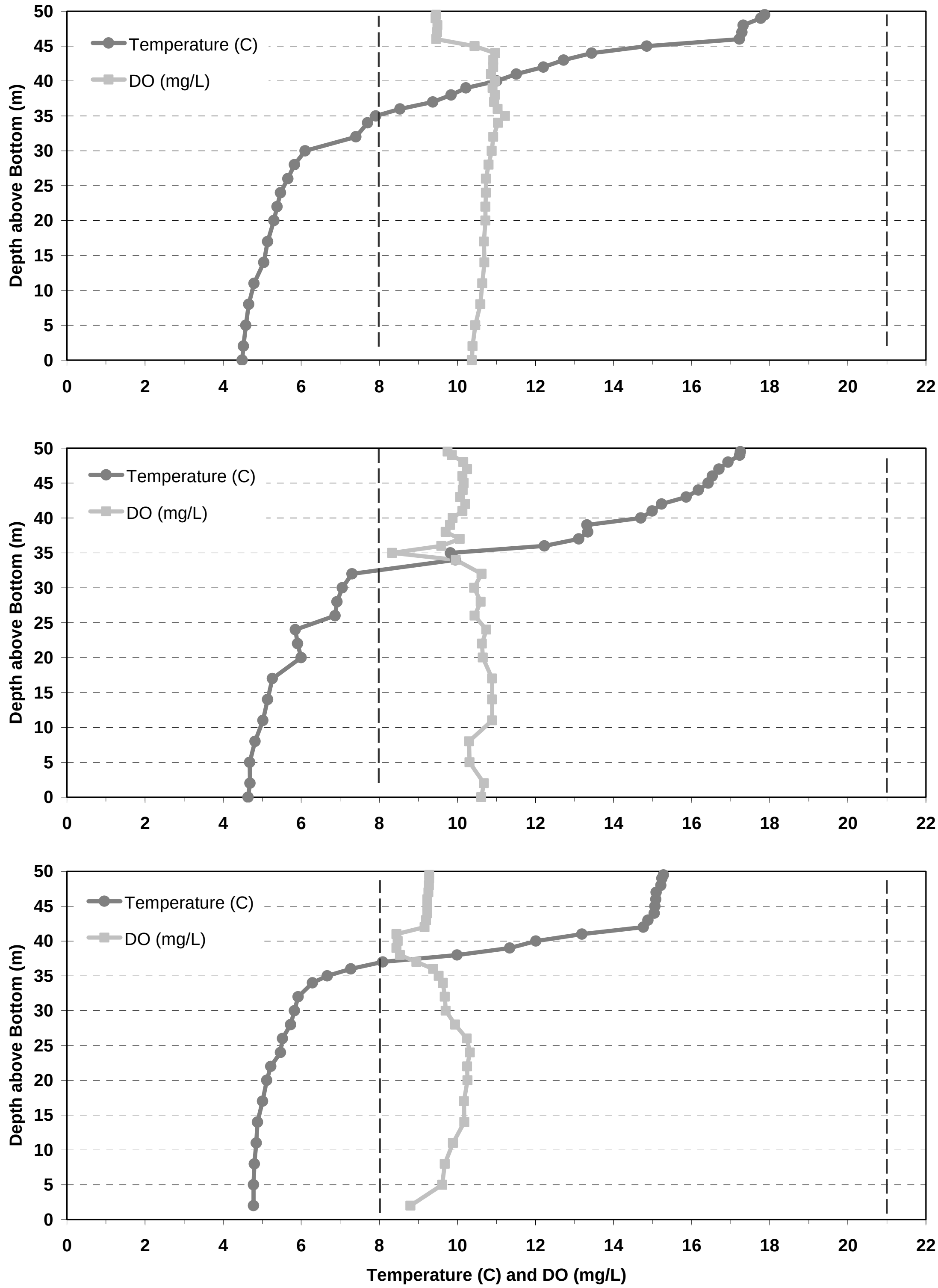
For purposes of determining water temperature and DO levels that are protective of beneficial use by fish (particularly trout) in the lake, it is assumed that suitable trout habitat in Spada Lake is maintained and supported at temperatures from 4 to 21ºC, and DO levels of 8.0 mg/L or greater. The range of temperatures from 4 to 21ºC is based on information from McCullough (1999) and Sullivan et al. (2000) on water temperatures that support or maintain growth of rainbow trout (or steelhead) in the Pacific Northwest.[11] The DO threshold of 8.0 mg/L is based on the Environmental Protection Agency (EPA) guidance (EPA 1986) on DO criteria that maintain and support growth of trout.

An examination of the profiles in Figures E.6.2-14 and E.6.2-15 relative to the water temperature and DO thresholds indicates that both water temperature and DO are at levels that support and maintain suitable habitat for trout in 100 percent of the lake's volume over the entire water column in July, August, and September. The consistent presence of entire portions of the water column that meet these water quality thresholds indicates that suitable habitat for fish in Spada Lake are maintained and protected. A similar analysis was performed and a similar conclusion was reached by Pfeifer et al. (1998) on a sport fishery evaluation of Spada Lake in 1998.

[11] Sullivan et al. (2000) indicate that optimal growth within the "zone of preference" occurs between about 12 and 17^{o}C. Between about 17 and 21^{o}C, the tolerance to higher temperature increases with food availability. At 21^{o}C, Sullivan et al. (2000) predict a 10 percent reduction in maximum growth of rainbow trout (or steelhead). However, a 10 percent reduction in maximum growth would be statistically unmeasurable from no reduction in maximum growth given the typical range of body sizes by age in natural populations.



Figures E.6.2-14 Vertical profiles of water temperature and DO in Spada Lake in July (top plot), August (middle plot), and September (bottom plot) 2007. Vertical hatched lines are placed at 21°C and 8 mg/L to represent conditions to support and maintain fish (trout) in the lake as explained in the text.



Figures E.6.2-15 Vertical profiles of water temperature and DO in Spada Lake in July (top plot), August (middle plot), and September (bottom plot) 2008. Vertical hatched lines are placed at 21°C and 8 mg/L to represent conditions to support and maintain fish (trout) in the lake as explained in the text.

E.6.2.2.2.4 Turbidity

Turbidity values were less than 5 NTU in 95 percent or more of grab samples obtained in the tributaries to Spada Lake during the water quality study. In Spada Lake, turbidity values were less than 5 NTU in 86 percent of grab samples taken near surface (0–5 m), 100 percent of samples taken at mid-depth (6–16 m), and 71 percent of samples taken near the lake bottom (42–52 m). Turbidity grab sample values in the Sultan River downstream of Spada Lake were less than 5 NTU in 77 to 92 percent of grab samples obtained during the study. As such, grab sample values at downstream sites were relatively low most of the time, but generally exceeded 5 NTU more often than at the upstream tributary sites.

The generally higher turbidity in the Sultan River downstream of Spada Lake does not have an obvious Project-related cause, and is explainable by other non-Project-related watershed processes and responses. In general, potential turbidity-causing aspects of hydroelectric facilities and operations can include: potential erosion of reservoir shoreline or exposed tributary deltas caused by fluctuations or drawdown in the level of the reservoir; potential erosion of downstream channels due to flows from dam releases; or potential erosion from other in-water or streamside maintenance activities (Ecology 2005). Alternately, reductions in turbidity in flows entering a hydropower reservoir can occur from sediment settling in the reservoir.

The Water Quality Final Technical Report (CH2M Hill 2009) contains an analysis showing that variation in turbidity generally corresponded to seasonal changes in precipitation, the occurrence of relatively large rainfall events, and flow conditions. During the fall months, increases in precipitation and flow conditions corresponded to contemporaneous increases in turbidity. During winter months, turbidities were consistently relatively low despite increases in precipitation, which likely was the result of precipitation accumulating mainly as snow at this time with relatively low turbidity-causing runoff. During summer months, variation in turbidity appeared to be “event-based”, with episodic increases in turbidity occurring in response to occasional rainfall events and increased flows.

Bechtel Civil & Minerals, Inc. (Bechtel 1981) conducted a previous detailed study on turbidity in Spada Lake and the Sultan River that involved data collection, analysis, and numerical simulation to evaluate the effects of the Stage II development of the Project. Bechtel (1981) determined that the principal influx of turbidity entering Spada Lake occurs as a result of highly turbid inflows from the upstream tributaries during winter storms (November through January). Bechtel (1981) concluded that most of the turbidity entered the lake from the tributaries in a matter of 2 or 3 days during these events. Bechtel (1981) also assessed sources of turbidity to the lake other than from the tributaries, and concluded that other potential sources, such as wave-induced lake shoreline or bank erosion, did not contribute measurable quantities of turbidity in comparison with that carried by the tributaries.

Bechtel (1981) determined that, because Spada Lake is well-mixed during winter, the incoming turbidity events become rapidly mixed and diluted in the lake. Therefore, the disposition of incoming turbidity events is analogous to the passage of a runoff flow event through a reservoir. Just as the peak flood discharge is reduced through a reservoir, so is the turbidity magnitude reduced. Similarly, just as the recession of the flood hydrograph is extended over a longer period of time than would have occurred without the reservoir, so is the recession in turbidity extended by passage through the reservoir. This reservoir effect has been observed in other similar hydropower reservoirs. For example, the Section 401 certification for the Baker River Hydroelectric Project (FERC No. 2150) describes the situation whereby the Baker Project reservoirs store turbid water and release it at a lower magnitude and at a slower rate than would occur naturally without the dams (Ecology 2007).

Bechtel (1981) also examined the dynamics of turbidity concentrations in Spada Lake based on profile measurements and numerical modeling. There were times, particularly in winter, when turbidities in the bottom part of the lake were substantially higher than in the top part of the lake (Bechtel 1981). This same condition was observed in the turbidity profile obtained in December 2007 as presented in the Water Quality Final Technical Report (CH2M Hill 2009). Bechtel (1981) concluded that this condition was caused by highly turbid inflow events from the tributaries that enter the lake and sink to lower levels of the lake because of the higher density of these turbid inflows. High bottom turbidities do not translate to similarly high turbidities in releases from the lake because the lake outlet draws from variable depths (Bechtel 1981). During the summer, turbidity in Spada Lake is uniformly relatively low, primarily because tributary runoff events are infrequent at that time and inflows are clearer (less turbid).

E.6.2.2.2.5 Nutrients and Chlorophyll-a

As described above in Section E.6.2.1.2.2, nutrient and chlorophyll-a values during the 2-year water quality study were consistently low at all sites, indicating a low potential for any high (or nuisance) primary production (e.g., algae growth). The state water quality action values for TP concentrations indicate that the trophic state classification of Spada Lake is oligotrophic. These oligotrophic conditions signify that nutrient enrichment and high algal production are not present as potential effects relative to Project facilities or operations.

E.6.2.2.2.6 pH and Alkalinity

Most pH values obtained during the 2-year water quality study were within (and therefore met or complied with) the designated Core Summer Salmonid Habitat pH criterion range of 6.5 to 8.5 (WAC 173 201A 200). Instances of pH outside this range occurred at all sites, including at tributary sites upstream of the Project area. When outside the range, pH values were consistently on the low (i.e., slightly acidic) side of the range. In addition, alkalinity values were consistently low at all sites throughout the study, indicating a low buffering capacity.

These results indicate that pH and alkalinity conditions in the Project area are not affected by Project facilities or operations. All sampling site – including tributary sites, Spada Lake, and the Sultan River downstream of Spada Lake – are similarly circumneutral to slightly acidic with low buffering capacity. Circumneutral to slightly acidic conditions with low buffering capacity are characteristic of western Cascades freshwaters (Welch et al. 1998, Hayslip et al. 2004). Slightly acidic rainfall occurs in the western Cascades and the capacity of the solutes of water to buffer and neutralize acid is generally low (Welch et al. 1998). Therefore, the factors that determine pH conditions observed during the water quality study appear to be related to naturally-occurring watershed processes.

E.6.2.2.2.7 Fecal Coliform Bacteria

As described above in Section E.6.2.1.2.2, the geometric means of the detected values of fecal coliform bacteria obtained during the 2-year water quality study were less than the state standard (WAC 173 201A 200). Therefore, the water quality standard for fecal coliform was met at all sites. The results indicate that Project operations or area uses have no detrimental effect with regard to fecal coliform bacteria.

E.6.2.2.2.8 Total Dissolved Gas

As described above in Section E.6.2.1.2.2, TDG measurements were collected at the Sultan River below the Powerhouse (tailrace) at RM 4.4 to assess potential TDG entrainment from Powerhouse turbine operation. TDG data from monthly measurements ranged from 84 to 106 percent during the 2-year water quality study. TDG data from continuous hourly measurements obtained during multi-day events in June and July 2008 ranged from 101 to 104 percent saturation. These TDG values were less than (and therefore met or complied with) the designated state criterion, and indicate that TDG conditions in the Project area are supportive and protective of beneficial uses. The TDG measurements demonstrate that TDG supersaturation (i.e., TDG saturation greater than 110 percent) from potential Powerhouse turbine air entrainment does not occur.

E.6.2.2.2.9 Other Parameters

The TPH data collected during the 2-year water quality study did not indicate that diesel- and oil-range hydrocarbons were currently present in the Sultan River in the Project area. The results obtained during the study for other parameters, such as conductivity and total dissolved solids (TDS), further indicate good water quality with dilute dissolved solids and ions content. The data do not indicate any Project-related effects on these other parameters.

E.6.2.3 Proposed Environmental Measures

As part of relicensing, the District conducted numerous studies of water and aquatic resources of the Sultan River. Several of the studies were designed to determine the quality of water in the Sultan River and the effect of Project operations on water quality. In addition, several aquatic resource studies of habitat processes and availability under current Project operations considered water quantity attributes, such as peak flow duration and magnitude, and seasonal minimum stream flows. The results of these studies, coupled with existing information, are the basis for the proposed PM&E measures for water resources at the Jackson Project. These measures (discussed below) are intended to minimize the impacts associated with the continued operation of the Jackson Project and to enhance the habitat benefits afforded to aquatic resources over the course of the next license term.

E.6.2.3.1 Development of Water Resource PM&Es

All of the water resource/stream flow related measures are closely intertwined because they all primarily rely on the yearly water budget of the Spada Lake subbasin. This section is intended to further clarify Project operational and water budget constraints and how water resource measures were developed to account for competing demands. The effects analysis of individual PM&Es follows this section.

The ultimate Project operational challenge is to work within an annual water budget to meet multiple demands for water. These include municipal supply for the City, aquatic habitat, power generation to meet societal demands, and recreational and cultural opportunities, while providing incidental flood control to protect life and property. In many cases, demands compete against one another for the same water. Following is an integration of the basin hydrology and these competing resource needs.

E.6.2.3.1.1 Sultan Basin Hydrology and Project Operational Constraints

The District modeled Project operations by synthesizing natural daily flows over the 109-year hydrologic period of record of the Sultan River basin (1889 to 2008), and then applied Project operational constraints and water resource allocations. The ultimate goal of the modeling exercise was to determine if all of the various water resource needs could be met within each water year over the 109-year modeled period under various operational scenarios.

There are several constraints on Project operations which are arranged in a hierarchy of priority in the model, including:

- City water supply needs must always be satisfied.
- Minimum stream flows for aquatic resources below Culmback Dam, the Diversion Dam, and the Powerhouse must always be satisfied.
- Control maximum flow during the fall Chinook spawning season (to the extent possible) from September 15 to October 15 to reduce potential for redd dewatering during subsequent period of egg incubation.
- Operate the Project to maintain the reservoir above elevation 1,380 feet msl. When Spada Lake drops below this level, water cannot be withdrawn through the power tunnel, and City water demand and minimum stream flows for aquatic resources must be met by releases through valves at the base of Culmback Dam. Depending on the season, such releases can be unnaturally cold and have detrimental effects on aquatic resources, such as to spawning salmon and incubating salmon eggs.

<u>Accounting for Future City Water Demand</u>

The City is the wholesale water supplier for 80 percent of Snohomish County and has rights for the use of 380 cfs (245.6 mgd) of Sultan River water for municipal supply, and has a pending application for an additional 200 cfs (129.3 mgd). The District is obligated by agreement with the City to operate the Jackson Project to meet the City’s water supply demands. The City has evaluated its water demand out to a 60-year planning horizon and projects that current demand (84 mgd) will more than double before 2050, even with conservation. For the purposes of analyzing effects of the proposed Jackson Project operation and PM&E measures on the environmental baseline (existing conditions), the current City water demand of 84 mgd is the existing condition in 2008. The effect of reasonably foreseeable future water demand on water resources is analyzed under *Cumulative Effects* (Section E.6.2.4). For perspective on the City's current water demand, 84 mgd equals about 130 cfs, which accounts for 17 percent of the Sultan River subbasin average annual inflow of 768.5 cfs (based on gage data from 1929 to 2008). Minimum stream flow requirements below the Powerhouse under existing conditions vary between 165 and 200 cfs seasonally, and equal a combined average yearly continuous flow of 192 cfs. The City's current total water right of 380 cfs plus current minimum stream flows averaging 192 cfs equal about 75 percent of the average daily inflow to Spada Lake.

Operational Constraints

Project generation currently averages 421,800 MWhs annually based on a computer simulation of current operations with City water demand of 84 mgd. This represents approximately 5 percent of the District's annual need for power. Maximum generation capacity (approximately 100 MW, depending on the elevation of Spada Lake) equals a maximum Powerhouse discharge of about 1,300 cfs. Because the District has a contractual obligation to deliver up to 246 mgd of water to the City (380 cfs), water supply and minimum stream flows have first priority. As explained previously, these are met through the Francis units, which deliver water to Lake Chaplain for distribution. Flows above those needed for water supply or minimum stream flows pass through the Pelton units to generate power at the highest head available.

The Project withdraws reservoir water through the water control tower when Spada Lake is above reservoir elevation 1,380 feet msl. When Spada Lake is thermally stratified (late spring to late fall), water of a desired temperature is withdrawn to benefit aquatic resources downstream of the Diversion Dam (OR-2) and Powerhouse (OR-1). When the reservoir is below elevation 1,380 feet msl, power tunnel withdrawals would be terminated to avoid vortexing and minimum stream flows for reaches OR-1 and OR-2 must be released from the base of Culmback Dam. The bottom water layer of Spada Lake is unnaturally cold compared to temperatures that seasonally occur within OR-1 and OR-2. Release of such cold water is not biologically preferred, especially in the late summer and fall when salmon begin to spawn.

A major constraint of Project operations is the relatively small size of Spada Lake. The reservoir has a total volume (storage capacity) of 153,260 acre-feet at full pool (elevation 1,450 feet msl) which is only one third of the average annual volume of Spada Lake inflow. The size of the reservoir limits the amount of water that can be captured during peak flows (when inflows can exceed outflows by a factor of 10) and distributed at other times of the year to meet demands such as City water supply and increased minimum stream flows.

Simulation Model

The District uses a computer simulation model to understand current and proposed Project operations. The model is based on a daily time step of volumetric water quantities entering the Sultan River system at various points from Spada Lake to the Powerhouse including Lake Chaplain. The model accounts for and prioritizes meeting the City's water demand and minimum stream flow requirements below Culmback Dam, the Diversion Dam, and the Powerhouse. Model inflows are updated annually and calibrated to accurately reflect reservoir fluctuations and power generation.

A simulated history of input flows for the model has been reconstructed from actual gaging data and early records of nearby river systems. This history dates from July 1, 1899 to June 30, 2008 (109 years of daily flows in the Sultan River system). With this data, the District can define and run various operational scenarios, incorporating different operational rules such as reservoir elevation targets, water supply withdrawals, and minimum stream flow levels. The model runs can be used to determine when reservoir elevations would fall below elevation 1,380 feet msl, causing water to be released from the base of Culmback Dam to meet water needs (affecting water temperature in each of the operational reaches), or whether the reservoir would run dry in a drought year. A host of other attributes can be determined by post-processing the model output, such as quantification of aquatic habitat area that may be provided with various operational scenarios.

The District used the operations model to test various flow scenarios that protect the City water supply while increased minimum stream flow levels for aquatic resources. Meeting City water demand and preventing the reservoir from dropping below elevation 1,380 feet msl turned out to be the driving factors in defining the magnitude of minimum stream flows that can be provided by the Project.

By slightly adjusting the reservoir operation rule curves, implementing minimum target reservoir elevations, and implementing the reservoir elevation conservation trigger[12], over a 50-year license term, the modeling exercise indicates the Project can be operated to:

- Meet the City water demand of 84 mgd
- Increase minimum stream flows and resultant aquatic habitat area
- Provide special purpose flows (such as habitat process flows and whitewater boating trial flows)
- Reduce the risk of spill during the Chinook spawning period
- Provide incidental flood control
- Minimize the frequency and duration that the reservoir level is below elevation 1,380 feet msl
- Preserve the City of Everett's water supply "safe yield"

[12] Gradual step-wise reduction in minimum stream flow releases to OR-1 and OR-2 during dry years based on reservoir level elevations to reduce the risk of the reservoir falling below elevation 1,380 feet msl.

However, as City water demand increases beyond current demand (which must be satisfied), the overall remaining water budget decreases may lead to low reservoir elevations and more frequently power-off periods. With higher proposed minimum stream flows below the Powerhouse, Project operations cannot completely mitigate effects of increased City water demand over the long term. Based on the modeled scenarios, as water demand increases, the frequency when minimum stream flow triggers are implemented would increase, and (on average) the reservoir would be drawn down longer and further each year. Consequently, the chance of reservoir levels dropping below elevation 1,380 feet msl increase each year, and the chance of totally draining the reservoir during a severe drought also increases. Please see the *Cumulative Effects* (Section E.6.2.4) for a detailed analysis of the effects of increased City water demand on water resources.

E.6.2.3.2 Water Quantity PM&E Analysis

Project operations seasonally affect Sultan River flows. The District proposes the following actions that would influence seasonal flows in the Sultan River: modify the Sultan River minimum stream flow schedule to benefit fish and other aquatic resources, provide a 3-year trial period of recreational whitewater boating flows, modify the Pelton units to provide flow continuation in the event of inadvertent shutoff, provide a new minimum stream flow release point near the Diversion Dam, and implement additional downramping measures. To accomplish these objectives, the District also proposes to revise the reservoir level operational rule curve to accommodate these flow release modifications and to provide additional resource protection against flooding during or immediately following salmon spawning. The proposed operational changes are represented by several PM&Es that would work in a coordinated fashion to alter seasonal water quantity within a given year's water budget when compared to existing conditions. Important individual PM&E components that would influence Spada Lake and Sultan River flows include:

- Modify reservoir operational rule curves to meet all flow related PM&Es over a 50-year license term
- Implement minimum reservoir elevation targets and a conservation trigger to maintain beneficial Project control of water release points and water temperature
- Modify the minimum stream flow release point near the Diversion Dam
- Modify minimum stream flow requirements at the Diversion Dam and Powerhouse
- Provide juvenile fish outmigration and adult fish upstream migration flow releases
- Control maximum flow during salmon spawning
- Provide habitat process flows
- Install and operate Powerhouse Pelton unit flow continuation system
- Modify Project downramping requirements
- Provide whitewater boating flows over a trial 3-year period

The environmental effects of each of these PM&E components, which would influence water resources, are analyzed below.

E.6.2.3.2.1 Modify Minimum Stream Flow Requirements in OR-1 and OR-2

Issue

The Project's water storage and release at three discharge points in the lower Sultan River (Culmback Dam, Diversion Dam, and Powerhouse) affects seasonal minimum stream flows in the river. Minimum stream flow requirements affect aquatic community persistence and productivity.

Proposed PM&E

The District proposes to meet specified minimum stream flows in OR-1, OR-2, and OR-3 to protect, mitigate, and enhance fish and wildlife resources, riparian vegetation, aesthetic resources, and water quality in the Sultan River. Proposed minimum stream flow requirements at the USGS Gaging Station 12137800 would seasonally range between 100 and 200 cfs. Minimum stream flow requirements at the Powerhouse (USGS Gaging Station No. 12138160) would be 300 cfs year round. No changes are proposed for the bypass reach (OR-3) from RM 9.7 to 16.5; the year round-release of 20 cfs from Culmback Dam would remain unchanged from existing conditions. Appendix B fully describes this PM&E.

Environmental Analysis

The goal of this PM&E measure is to manage and regulate flows in the Sultan River in a manner that provides habitat suitable for the production of healthy and sustainable resident and anadromous fish populations while continuing to meet the City's water demands. The effects of implementing the minimum stream flows on water quantity are listed below. Effects of changing minimum stream flows on aquatic resources, such as fish and habitat, are discussed in Section E.6.3.3.1.1.

The proposed seasonal allocation of minimum stream flows (Table E.6.2-7) would result in the following changes in the magnitude of minimum stream flows in OR-1 (downstream of the Powerhouse) when compared to existing conditions (in all but dry years):

- 50 percent increase from September 15 to June 15
- 82 percent increase from June 16 to September 14

Changes in the magnitude of minimum stream flows in OR-2 (between the Diversion Dam and Powerhouse) compared to existing conditions would be (in all but drought years):

- 5 percent increase from November 1 to January 15
- 33 percent decrease from January 16 to February 29
- 43 percent decrease from March 1 to March 15
- 20 percent decrease from March 16 to June 15
- 5 percent increase from June 16 to September 14
- 38 percent increase from September 15 to September 21
- 35 percent increase from September 22 to October 31

Table E.6.2-7 Proposed and current (in parentheses) minimum stream flow requirements for OR-1 and OR-2 of the Sultan River.

Dates	Reach 2 [a]: Diversion Dam Minimum Stream Flows (cfs)	Reach 1 [b]: Powerhouse Minimum Stream Flows (cfs)
January 1-15	100 (95)	300 (200)
January 16-31	100 (150)	300 (200)
February	100 (150)	300 (200)
March 1-15	100 (175)	300 (200)
March 16-30	140 (175)	300 (200)
April	140 (175)	300 (200)
May	140 (175)	300 (200)
June 1-15	140 (175)	300 (200)
June 16-30	100 (95)	300 (165)
July	100 (95)	300 (165)
August	100 (95)	300 (165)
September 1-14	100 (95)	300 (165)
September 15-21	200 (145)	300 (200)
September 22-30	200 (155)	300 (200)
October 1-31	200 (155)	300 (200)
November	100 (95)	300 (200)
December	100 (95)	300 (200)

[a] Measured at USGS Gaging Station No. 12137800 (same compliance point as under existing conditions).
[b] Measured at USGS Gaging Station No. 12138160 (same compliance point as under existing conditions).

Under existing operations, there have been no minimum stream flow excursions that were considered violations by FERC since 1994 at the Powerhouse and since 1993 at the Diversion Dam. Compliance with the proposed minimum stream flow regime would be the same as under existing conditions (see Section E.6.2.2.1.1).

E.6.2.3.2.2 Implement Minimum Reservoir Elevations and Conservation Trigger

Issue

The Project must stop withdrawing water through the intake tower when the reservoir level drops below elevation 1,380 feet msl, eliminating the Project’s ability to control the temperature of minimum stream flow release at the Powerhouse and Diversion Dam. When the reservoir level drops below elevation 1,380 feet msl, minimum stream flow requirements are met through release of water through the Howell-Bunger valves at the base of Culmback Dam. Providing minimum stream flows through these valves can release unfavorably cold water from the reservoir bottom during critical ecological periods, such as Chinook salmon spawning and early egg incubation.

Proposed PM&E

The primary goal of implementing minimum reservoir elevation targets and the conservation trigger is to minimize frequency and duration of reservoir elevation below 1,380 feet msl while increasing minimum stream flow requirements as previously described. The District will attempt to maintain a minimum impoundment in Spada Lake above elevation 1,430 feet msl between July 1 and August 15, and above elevation 1,420 feet msl from August 15 to September 15.

By providing the higher minimum stream flows described in Section E.6.2.3.2.1 in dry years, modeling indicates the reservoir may be drawn down below 1,380 feet msl. To reduce the chance of this occurrence, the District proposes to reduce minimum stream flow requirements (potentially down to existing Project minimum stream flow requirements during certain periods) in a step-wise fashion to conserve reservoir water and maintain beneficial Project control of minimum stream flow releases. In OR-1 the trigger would start when the reservoir elevation drops below 1,420 feet msl and would gradually reduce the OR-1 minimum stream flow from 300 to 200 cfs in a step-wise manner as reservoir levels drop (varying by season throughout the year). In OR-2 the trigger would only apply from September 15 to October 31. The trigger would start when reservoir elevations drop below 1,420 feet msl and would gradually reduce the OR-2 minimum stream flow from 200 to 150 cfs in a step-wise manner as reservoir levels drop. By implementing the conservation trigger, the proposed minimum stream flows in OR-1 and OR-2 would gradually stair-step down based on reservoir elevation triggers (see Appendix B for full PM&E description).

Environmental Analysis

At the current City of Everett water demand of 84 mgd, the proposed operational scenario conservation trigger would reduce flows downstream of the Powerhouse (OR-1) below 300 cfs in 98 of 109 modeled years (90 percent of modeled years). The number of days with reduced minimum stream flows (below 300 cfs) within the 109 year model period was 4,858, or 12 percent of the time. Approximately 66 percent of these days occurred from August through October (Table E.6.2-8), with an average yearly duration of 29 days during that time. In the model run the lowest "reduced flow" was 275 cfs, which exceeds the highest minimum stream flow level under existing conditions (200 cfs in OR-1). Therefore, modeling suggests that proposed minimum stream flow rules provide consistently higher minimum stream flows throughout the year when compared to existing conditions.

From September 15 to October 31, reverting to the lower-most conservation trigger flow in OR-2 (150 cfs) would provide about the same minimum stream flow as current conditions (ranging from 145 to 155 cfs during that time). However, over the 109 year model run, the reservoir elevation conservation trigger did not result in reduced flows below the proposed minimum of 200 cfs from September 15 to October 31. Therefore, modeling suggests that proposed minimum stream flows provide consistently higher minimum stream flows during September 15 to October 31 when compared to existing conditions.

Table E.6.2-8 Number and percent of days within the 109 year model run that minimum stream flows are below 300 cfs (City water demand = 84 mgd).

Month	Number of Days flows <300 cfs	Percent of Days flows <300 cfs
January	406	8.4
February	168	3.5
March	105	2.2
April	132	2.7
May	9	0.2
June	10	0.2
July	174	3.6
August	897	18.5
September	1111	22.9
October	1237	25.5
November	467	9.6
December	142	2.9

The proposed minimum stream flow of 20 cfs in OR-3 was met in all 109 modeled years. Current minimum stream flow requirements are 20 cfs in this reach; therefore, modeling suggests that proposed operations would maintain existing conditions in OR-3.

The effects of reverting to current minimum stream flows (i.e., if this reservoir elevation trigger is met) on aquatic resources are discussed in Section E.6.3.3.1.1.

E.6.2.3.2.3 Minimum Stream Flow Management by the Aquatic Resource Committee during Drought Years

Issue

In an extreme drought year, providing all of the flow measures and increasing the City's water demand over the next 50 years may compromise the ability of the Project to provide water to the City based on its allocated water rights. The Project is obligated to meet the City's water withdrawal rights.

Proposed PM&E

During the course of a water year, the ARC[13] may recommend a drought release schedule when: (1) the ARC determines that a drought event (as defined by the City of Everett's most current Drought Response Plan) is probable; (2) the release schedule described in this PM&E requires interim modification to manage water supply during periods of

[13] As discussed in Section E.6.3.3, the District plans to establish and convene an Aquatic Resource Committee (ARC) within 30 days of issuance of the License for the purpose of consultation and assistance in implementation by the District of specific license articles.

weather-related shortages; and (3) the drought release schedule will not undermine the purposes of this PM&E. Upon such recommendation, the District will notify the Commission and will implement the drought release schedule within seven days of providing such notice, unless otherwise directed by the Commission. See Appendix B for full PM&E language.

Environmental Analysis

The City's plan defines a drought event as when Spada Lake is lower than 80 percent of historical average and the snowpack is less than 80 percent of average in the spring.

Under the 109-year model run that implemented all of the proposed flow measures, the City's water demand was always met. Under a severe drought scenario, the ARC may modify minimum stream flows along with other water conservation measures to reduce the chance of Spada Lake going dry. However, the model showed that even with the proposed minimum stream flow measures, Spada Lake would not have been drained during the most severe model drought year (1987-1988) while supplying 84 mgd to the City. At existing City water demand, the minimum reservoir elevation during the most severe modeled drought was elevation 1,364.6 feet msl, about 120 feet above the elevation at which Spada Lake would be completely drained (elevation 1,240 feet msl). Therefore, modeling suggests the chance that minimum stream flows would actually need to be modified by the ARC to preserve the City's water needs would be small at current demand. In addition, the City could potentially implement further water conservation measures to avoid the need to lower minimum stream flows during a severe drought.

E.6.2.3.2.4 Modify the Maximum Flow Ceiling during the Chinook and Pink Salmon Spawning Period

Issue

Chinook and pink salmon redds produced at high flows may be dewatered during the incubation period if the spawning flow is significantly higher than the incubation flow. Increasing the current maximum flow ceiling from 400 cfs to 550 cfs would ensure continued successful incubation should flows drop to Project minimum stream flow requirements.

Proposed PM&E

Under this proposed PM&E, the District would increase the maximum flow ceiling in OR-1 from 400 cfs to 550 cfs during the September 15 to October 15 peak spawning period. Based on previous habitat/flow studies conducted by the District, the stage associated with this ceiling would ensure that redds remain wetted should Project flows be reduced to the minimum of 300 cfs. Furthermore, the District would use spawner survey information to determine the highest relative channel elevation at which spawning has occurred during Chinook and steelhead spawning seasons. The District would attempt to keep redds covered with water until fry emergence has occurred. The spawning flow ceiling and corresponding minimum stream flow may be adjusted per consultation with the ARC. See Appendix B for the complete PM&E language.

Environmental Analysis

The District currently imposes a 400 cfs maximum flow ceiling during the Chinook and pink salmon spawning period. This ceiling is thought to provide protection if flows drop to the current 200 cfs minimum during incubation. Similarly, the District believes that a commensurate 550 cfs ceiling during spawning should be adopted with the proposed increased minimum stream flow of 300 cfs during incubation. Under current operations, daily flows exceed 550 cfs about 10 percent of the time below the Powerhouse in late September, and between 25 and 50 percent of the time in early October (Figure E.6.2-5). In modeling proposed operations, flows exceeded 550 cfs in 76 of 109 years and in 10.5 percent of all modeled days between September 15 and October 15 (8 percent of modeled days from September 15 to 30 and 13 percent of modeled days from October 1 to 15). Therefore, modeling suggests that limiting flows to 550 cfs from September 15 to October 15 should reduce the frequency of occurrence of these higher flows when compared to existing conditions.

E.6.2.3.2.5 Provide Habitat Process Flows

Issue

The frequency, magnitude, and duration of peak flood flows in the Sultan River have been reduced under Stage II operations. While reducing flood flows has allowed the establishment, persistence, and in some cases proliferation of salmon and steelhead below the Diversion Dam, this flow regime has also reduced the active channel area and impacted the creation and maintenance of side channels in the three-mile alluvial reach of the Sultan River (OR-1). Specifically, Stillwater Sciences and Meridian Environmental (2008b) concluded:

- Vegetation encroachment in the lower alluvial reach has been an unforeseen consequence of flow alteration. Riparian vegetation has reduced the active channel area by 32 percent since Stage II operations began.

- Side channels in the Sultan River are relic features, a consequence of vegetation encroachment into formerly active channels of the river.

Although the gravel transported through the lower Sultan River is considered to be good quality for salmonid spawning habitat and is mobilized about once every 3 to 4 years (Snohomish County PUD 1995; R2 Resource Consultants 2005), reduced peak flows have decreased habitat complexity in OR-1.

Proposed PM&E

While high flow events currently occur in the Sultan River, several stakeholders expressed an interest in providing additional high flow releases (process flows) to improve aquatic habitat in the lower Sultan River. The District proposes to provide a water budget of 22,000 acre-feet over a 50-year license term to provide controlled flows to supplement natural accretion flows, for geomorphic and channel maintenance purposes (collectively referred to as process flows). Water released from Culmback Dam pursuant to a scheduled process flow release and any downramping associated with such process flow releases (as required by the downramping PM&E) would be deducted from the 22,000 acre-feet water budget. The District, in consultation with the ARC, would schedule the timing of process flows to take advantage of accretion flows and Project generation to achieve geomorphic process goals within the longitudinal and lateral riverine ecosystem. See Appendix B for the full PM&E language.

Environmental Analysis

During a process flow event, the District would release water from Culmback Dam via the Howell-Bunger and slide valves. The combined maximum flow release capacity of these valves is 2,355 cfs at reservoir full pool elevation of 1,450 feet msl. The water budget of 22,000 acre-feet would sustain a flow of 2,355 cfs for 113 hours, which could be allocated to multiple process flow events over the term of a new license as determined by the District and the ARC. As specific volume, duration, and timing of process flow events has not been defined, the precise effects on the Sultan River hydrograph cannot be determined. However, in general, implementing process flows would increase the recurrence interval of higher flow events in the Sultan River compared to existing conditions. See Section E.6.3.3.3 for a discussion of effects on aquatic habitat from implementing the process flow PM&E.

E.6.2.3.2.6 Provide Whitewater Boating Flows

Issue

Seasonal storage of water in Spada Lake provides significant incidental floodwater storage, which has reduced peak flows downstream of Culmback Dam. Higher flows than those provided by the current minimum stream flow requirements are preferred by whitewater boaters (Whittaker and Shelby 2008).

Proposed PM&E

The District proposes a 3-year trial period to assess the long-term (i.e., license term) feasibility and implications (e.g., flows, use levels, costs, resource impacts, etc.) of providing whitewater boating flows on the Sultan River. Within 12 months after issuance of the License, the District would file a Whitewater Recreation Plan with the Commission. This plan would document how the District proposes to implement the study program to provide occasional higher flows in the Sultan River below Culmback Dam for whitewater boating while minimizing impacts to fish.

During the 3-year study program, the District would provide 900 acre-feet of water (total) for whitewater boating flow releases. Water released from Culmback Dam pursuant to a scheduled release and any downramping associated with release would be deducted from the water budget. In the event that a portion of the 900 acre-feet water budget remains after 3 years of implementing the study, the study program would continue until the balance of the water budget is released. See Appendix B for the complete PM&E language.

Environmental Analysis

This proposed measure would result in an overall increase in higher flow events in the bypass reach (OR-3) than occurs under existing conditions, and these higher flow releases would, in turn, affect flows in OR-2 and OR-1. The Flow Recreation Study (Whittaker and Shelby 2008) indicated that whitewater boaters found the minimum acceptable technical trip to occur at about 450 cfs, optimal technical trips at about 600 cfs, optimal standard trips at about 900 cfs and big water trips at about 1,200 cfs in the bypass reach. A continuous release at various flow rates (i.e., 450, 600, 900, 1,200 cfs) that does not exceed 900 acre-feet results in variable durations of time that could be allocated to one or more releases in 1 year or spread over a 3-year period (Table E.6.2-9). As specific release strategies are not defined, the actual effect on the Sultan River hydrograph will be unknown until the magnitude, duration, and timing of the boating flow releases are determined. Potential adverse affects of these flow releases on resident and anadromous fish in the lower Sultan River would be minimized through the implementation of timing restrictions developed in consultation with the ARC.

Table E.6.2-9 Maximum duration (hours) of potential whitewater boating flow releases without exceeding 900 acre-feet of storage.

Flow (cfs)	Duration (Hours)
450	24
600	18
900	12
1,200	9

E.6.2.3.2.7 Provide Juvenile and Adult Salmonid Migration Flow Releases

Issue

Project operations have reduced peak flows during the late spring juvenile salmon and steelhead outmigration period. Reduction in peak flows may influence juvenile fish outmigrant timing and survival. Project operations have also reduced high flow events in the late summer/early fall, although such events are rare in the Puget Sound region during this driest time of year. Stakeholders believe that reduction of high flow events during late summer/early fall may delay adult upstream migration timing, although there is no specific data stating to confirm or refute that this is occurring.

Proposed PM&E

Except in drought years, the District would provide juvenile fish outmigration flows and adult fish upstream migration flows from the Powerhouse.

1. Juvenile Outmigration Flow

If the daily average flow at the Powerhouse gage (USGS Gaging Station No. 12138160) is below 500 cfs for 14 consecutive days between April 15 and May 15 of any given year, the District will release a flow of between 800 cfs and 1,200 cfs from the Powerhouse for a duration of 12 consecutive hours on 3 separate days in May. The District, in consultation with the ARC, on an annual basis, will determine the necessity, schedule, and magnitude of the outmigration flow releases.

2. Upstream Migration Flow

Upon issuance of the License, if the ARC determines that a flow release is necessary to enhance adult salmonid upstream migration, the District will release a flow of up to 1,000 cfs from the Powerhouse for 24 hours at least one time annually during the first week of September.

See Appendix B for the complete PM&E language.

Environmental Analysis

Flows between April 15 and May 15 are typically above 500 cfs (see Figure E.6.2-5); however, about 25 percent of the time (i.e. 75 percent exceedence level in Figure E.6.2-5) flows are near or below 500 cfs. A flow event (below 500 cfs) occurring for more than 14 days in a row is fairly uncommon during that time; therefore, the proposed juvenile fish migration flow releases may be implemented on an infrequent basis. The recurrence interval of 12-hour duration flow events between 800 and 1,200 cfs would increase by a relatively small degree. Flows of 800 to 1,200 cfs are common during April and May (see Figure E.6.2.-5); the 50 percent exceedence level is just under about 700 cfs and the 25 percent exceedence level is generally well over 800 cfs during that time.

Flows during the first week in September are generally well under 1,000 cfs. The 25 percent exceedence level is around 500 cfs and the 90 percent exceedence level is only slightly over 1,000 cfs (see Figure E.6.2-5). If the ARC determines that a 1,000 cfs release is necessary on a yearly basis, the recurrence interval of flows of 1,000 cfs during early September could be greatly increased when compared to existing conditions.

E.6.2.3.2.8 Revise Reservoir Rule Curve

Issue

Project operations balance water withdrawals to meet the many competing needs of municipal water supply, electricity production, recreation, and ecological function. This management process begins with an operational rule curve developed to balance these needs over a water year, while taking into account important incidental flood control capabilities to protect property and human safety in the lower Sultan River and Skykomish/Snohomish River floodplains.

Proposed PM&E

The District proposes to implement a revised reservoir operations rule curve (Figure E.6.2-16) to balance competing resource needs and to ensure that the flow releases and controls described in the above PM&Es can be met to the greatest extent possible over the term of a new license. The rule curves were developed based on the physical storage capacity of Spada Lake and the hydrology of the Sultan basin. As discussed in Section

E.3.1.2 and Appendix A, the rule curves divide Spada Lake into five "states" that shift throughout the water year (July through June). This operational water year is used to minimize the change in storage from year to year, or in other words, maximize the predictability of water storage over the coming year to ensure a sufficient water budget to meet the resource needs.

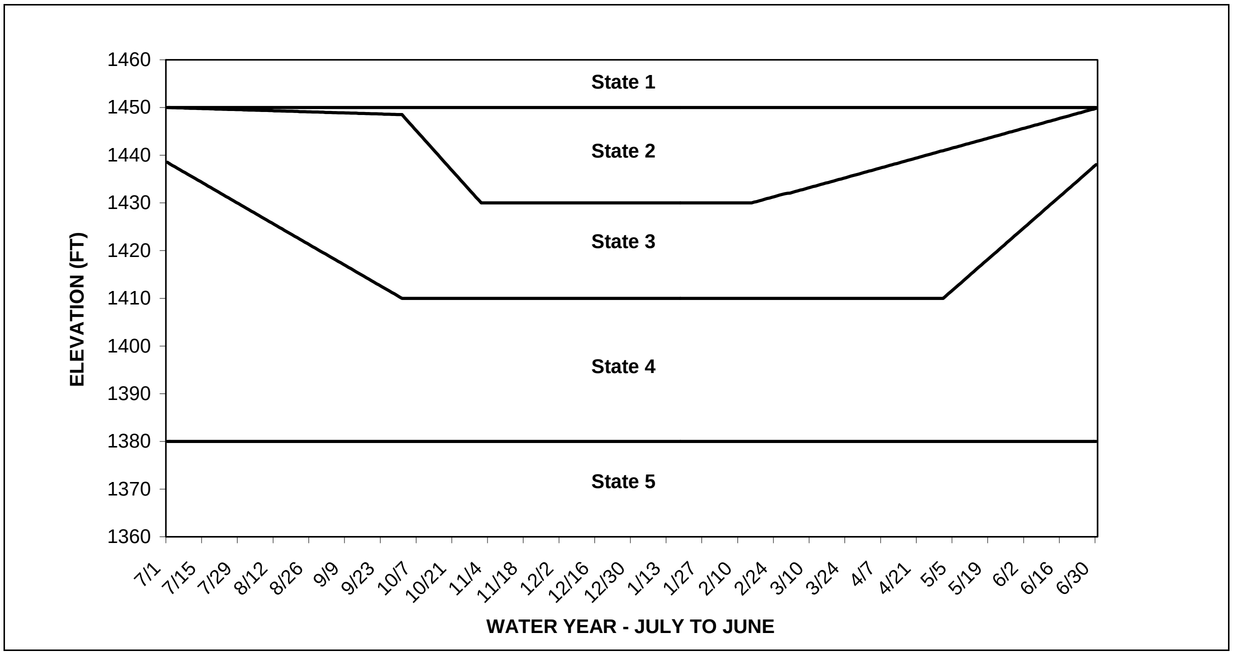


Figure E.6.2-16 Proposed Spada Lake operational rule curves.

The proposed general water management that occurs under each of the five operational stages is described below.

- State 1 – Zone of Spill: Above elevation 1,450 feet msl, Spada Lake would be in a state of spill. Therefore, the District would operate the Powerhouse to withdraw at least 1,300 cfs through the power tunnel to reduce a spill event as quickly as possible.

- State 2 – Zone of Potential Spill: The District would operate the Powerhouse to withdraw at least 1,300 cfs through the power tunnel to reduce the risk of spill, unless inflow forecasts show that there is minimal risk of spill.

- State 3 – Zone of Discretionary Operation: The District may operate the Powerhouse between the extremes of State 2 and State 4 depending on maintenance, power supply, and prudent operation to minimize the impacts to the aquatic resources.

- State 4 – Zone of Water Conservation: The District would operate the Powerhouse to satisfy the requirements of its water supply obligations to the City of Everett and the minimum stream flow requirements in the Sultan River. Generally, the Project is operated to conserve water unless inflow forecasts and snow pack measurements indicate higher water withdrawal for power production is warranted.

- State 5 – Zone of Tunnel Protection: Below elevation 1,380 feet msl, the District would withdraw water through the Powerhouse only in so far as vortices do not occur in the power tunnel. Vortices could cause power tunnel collapse from the negative hydraulic pressures. The District would satisfy minimum stream flow and water supply requirements at Culmback Dam, the Diversion Dam, and the Powerhouse by releasing water from the exit valves at the base of Culmback Dam. The exit valves are at elevation 1,220 feet msl.

- See Appendix B for the full PM&E language.

Environmental Analysis

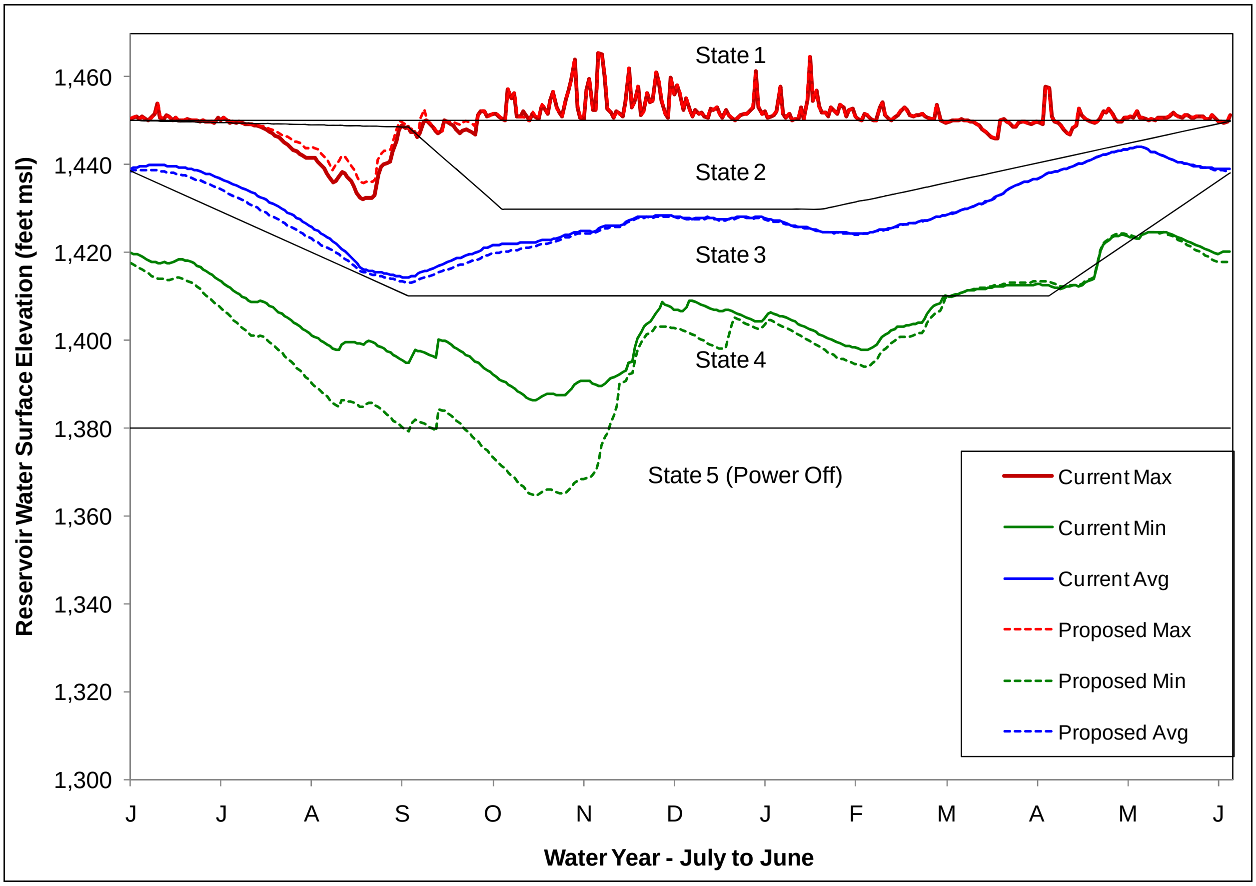
The District has noted that in some years, inflow from higher than normal precipitation during August, September, or October can keep the elevation of Spada Lake abnormally high. These circumstances can increase the risk of spill in October (rather than in November). Biologically, this is not preferable because spill in October may disrupt spawning Chinook salmon, a species that is listed as threatened under the ESA.

Under proposed operations, the reservoir would generally need to be ramped up and down a bit more (to capture more water) to provide the increased minimum stream flows. To reduce the risk of spill under the proposed operations, the District proposes to alter the State 3-4 rule curves to be a straight line from elevation 1,438.5 feet msl on July 1 to 1,410 feet msl on October 1. This would expand the State 3 operating zone from July through September, providing options to reduce Spada Lake water levels and the risk of a spill that would have the potential for undesirable effects on spawning salmon. Effects of the revised rule curve on spawning salmon and habitat are discussed in Section E.6.3.3.1.14.

Under current conditions, the recurrence interval for spill events from October through April is approximately 2.7 years, or about 37 percent chance of spill each year. Modeled operations suggest the recurrence interval for spill events would be about 2.5 years, or a 40 percent chance of spill each year from April through October. This is about the same as existing conditions through implementation of the revised rule curve.

Modeling suggests that in October (the peak of Chinook salmon spawning), spill would occur slightly more frequently under proposed operations than under existing conditions (6 compared to 4 of 109 modeled years), but the magnitude would be smaller, averaging 1,035 cfs under existing conditions, but 785 cfs under proposed operations. Average duration of each spill event was about the same at 4 days under both existing conditions and proposed operations.

Modeling was conducted to determine the effects of this measure on reservoir elevations. Based on modeling of the proposed rule curves and minimum stream flow requirements, the water level fluctuation patterns within Spada Lake are expected to be similar to conditions which would occur if current operations were continued (Figure E.6.2-17). The reservoir would be drawn down a bit further and longer each year under the proposed rule curves, especially in extreme drought years. During the worst case modeled (drought year 1987-1988), the reservoir would have been drawn below elevation 1,380 feet msl in October and November, which is represented by the minimum reservoir elevation line in Figure E.6.2-10.



(City of Everett Average Annual Water Demand = 84 MGD)

Figure E.6.2-17 Daily maximum, minimum and average reservoir elevations for the 109 year modeled scenarios of current conditions and proposed operations.

E.6.2.3.2.9 Pelton Unit Flow Continuation System

Issue

Because the Project stores and then releases water at three points in the lower Sultan River (Culmback Dam, Diversion Dam, and Powerhouse), seasonal minimum stream flows are affected. Releases from the Powerhouse (i.e., discharge through the turbines) largely control minimum stream flow levels downstream in the Sultan River. Under existing conditions, if the turbines are tripped off due to mechanical/ electrical failure or load rejection, a rapid decline in flow can occur, which has the greatest negative effect on aquatic resources during low flow periods. In addition, the current turbine configuration can result in exceedence of the downramping rate requirements, which can negatively affect aquatic resources.

Proposed PM&E

The District proposes and is currently proceeding[14] to install a governor control system in the Powerhouse to allow bypass of the flow through individually controlled turbine needle valves to the Sultan River. This measure is expected to greatly reduce the potential for an immediate reduction in Sultan River flow caused by inadvertent turbine shutdown. The District proposes to implement this solution by October 2009 in an effort to provide Pelton unit flow bypass capability as early as possible.

Environmental Analysis

Since the Jackson Project was constructed in 1984, a variety of circumstances have lead to either single or dual Pelton unit shutdowns. While these shutdowns are now rare (the last minimum stream flow incident that was considered a violation by FERC occurred in 1994), the potential still exists for rapid shutdowns, which could result in minimum stream flow excursions. While not all situations that might cause Pelton turbine shutdown can be mitigated (such as a power conduit failure), the probability and frequency for future unit shutdowns would be greatly reduced by implementing this PM&E. The overall effect of this PM&E on water quantity in the lower Sultan River (OR-1) would be the near elimination of Powerhouse downramping exceedence events due to the Pelton units tripping off line.

E.6.2.3.2.10 Revise Project Downramping Requirements

Issue

Project operations can affect Sultan River flow fluctuations over a few minutes to several hours in the reaches downstream of the Powerhouse and Diversion Dam. Although the Project is operated on an intermediate cycle rather than a load following basis (resulting in less frequent downramping than occurs at other hydroelectric projects), downramping can negatively affect aquatic resources as previously described.

Proposed PM&E

The District proposes to revise three downramping attributes to provide adequate protection for salmon and steelhead fry in the Sultan River downstream of the Diversion Dam (the area subject to Project ramping effects). These measures include:

- Continuing current ramping rate requirements at the Powerhouse (as described in Section E.6.2.1.1.2) with the following modifications to Table E.6.2-2:

    1. In the period November 1 to December 31, allow a “night” downramping rate of 6 inches per hour rather than 4 inches per hour in the highest flow range (1,500 to 750 cfs).

    2. Remove the application of footnote "c" from the periods September 16 to December 31. Footnote "c" states:

[14] No disagreement to this measure has been expressed by Project stakeholders.

"If river flow prior to downramping has exceeded 1,000 cfs for more than 72 hours, downramping through this flow range (750 to 600 cfs) occurs only after holding flow constant between 750 and 850 cfs for at least 6 hours of daylight and one overnight period."

- Proposed downramping rates for the new flow discharge structure near the Diversion Dam (as listed in Table E.6.2-3, Section E.6.2.1.1.2) would be included as a PM&E in a new FERC license.

- Limiting the frequency of Powerhouse downramping under conditions when fry are most vulnerable to stranding, as proposed in Table E.6.2-10.

Table E.6.2-10 Proposed Powerhouse downramping frequency limitations.

	Limit on Downramp Hours When Downramping > 1 in/hr	
Time Period	River Flows <750 cfs	River Flows >750 cfs
Total Seasonal Limit (January through May)	48 hours	No limit
Monthly Limit:		
January	16 hours	No limit
February	16 hours	No limit
March	16 hours	No limit
April	16 hours	No limit
May	16 hours	No limit

Environmental Analysis

Under the proposed ramping requirements, from November 1 to December 31, increasing the ramping rate to 6 inches per hour during the night hours would lower the stage of the Sultan River more quickly than under current operations, when flows are between 750 and 1,500 cfs. The effects of removing footnote "c" (Table E.6.2-2) would also result in a somewhat quicker stage change than occurs under existing ramping rules; however, overall downramping still would be at a low rate (i.e. 1 to 2 inches per hour depending on season).

The proposed ramping rules from January 1 to May 31 in the flow range of 300 to 200 cfs stipulate a day and nighttime ramping rate of 2 inches per hour. The proposed daytime ramping rate of 2 inches per hour would be more restrictive than occurs under existing conditions during January and February. Under existing conditions, a 4-inch per hour daytime ramping rate is allowed at flows below 300 cfs. Therefore, the proposed rate would slow the lower Sultan River stage change in OR-1 if the reservoir level conservation trigger was activated during January and February. Implementing the reservoir level conservation trigger at other times of the year would result in the same ramping rates as are allowed under existing conditions.

Effects of the revised ramping rates on fish stranding are discussed in Section E.6.3.3.4. Formally adopting ramping requirements at the Diversion Dam would continue to limit ramping as occurs under existing conditions.

An analysis of existing conditions showed that the proposed 48-hour ramping limitation (Table E.6.2-10) between January and May 31was exceeded in 5 of the last 14 years, but has not been exceeded since it was adopted as a conservation measure in 2005. The District expects that exceedence of downramping requirements would continue to be very infrequent (the last incident deemed a violation by FERC occurred in 1994), but would be further reduced by implementing the operational changes described in Section E.6.2.3.1.8.

E.6.2.3.3 Water Quality PM&E Analysis

As discussed above in Section E.6.2.2.2, water quality conditions in the vicinity of the Project are very good, and meet (or comply with) State water quality standards with few exceptions. Two new PM&E measures for water quality are proposed for implementation to ensure continued protection of water quality in the vicinity of the Project over the course of the next license term. These two PM&E measures include Water Quality Plan and Water Temperature Conditioning in OR-3 (see Appendix B). The Water Quality Plan would consist of water quality monitoring and management activities to ensure continued protection of water quality and to ensure compliance with State water quality standards over the term of the next license term. The Temperature Conditioning measure would condition the water temperatures released at Culmback Dam to enhance the temperature regime for aquatic resources in the bypass reach and ensure compliance with the State standards. The District also proposes to continue water temperature conditioning to match pre-Stage II temperatures at the Diversion Dam release point as occurs under existing conditions. Descriptions of these PM&E measures and their expected environmental effects are provided below.

E.6.2.3.3.1 Water Quality Plan

Issue

The Jackson Project, including operation of Culmback Dam, the proposed discharge structure, and the Powerhouse, regulates the delivery and routing of water within the Sultan River watershed below Project facilities. This regulation involves the flow of water spatially and temporally and has the potential to affect water quality designated beneficial uses in and downstream of the Project area. To issue a Section 401 water quality certification, Ecology needs reasonable assurance that the Project will conform to State of Washington water quality standards throughout the term of a new license.

Proposed Measure

The District proposes to develop and implement a Water Quality Plan to ensure continued protection of water quality and designated uses and to ensure compliance with State water quality standards over the term of a new license. The Water Quality Plan would document and guide the program the District would implement to comply with

State water quality standards in the Sultan River (WAC 173-201A). The Water Quality Plan would address four types of measures or procedures:

1. Water quality protection measures related to Project construction or maintenance activities;

2. Spill prevention and containment procedures;

3. Procedures for application of herbicides, pesticides, fungicides, and disinfectants around Project facilities, if needed; and

4. Routine monitoring of select water quality parameters in the Project vicinity.

The District would submit the Water Quality Plan to FERC, for approval, within 180 days of issuance of the License. The District would develop the Water Quality Plan in consultation with Ecology. Upon FERC approval, the District would implement the Water Quality Plan.

The routine monitoring of water quality parameters would be an important component of the Water Quality Plan to determine on-going compliance with state water quality standards in the Project area. The Water Quality Plan would contain, at a minimum, a list of parameter(s) to be monitored, a map of sampling locations, and descriptions of the purpose of the monitoring, sampling frequency, sampling procedures and equipment, analytical methods, quality control procedures, data handling and data assessment procedures, and reporting protocols.

Progress reports would be completed annually to provide an assessment of data collected during the year. The District would also use the yearly assessment to offer recommendations, as may be appropriate, for potential revisions to the Water Quality Plan. The District will seek approval by Ecology of any revisions of the Water Quality Plan. If revised, the District would submit the revised plan to FERC for approval. If the District submits the revised Water Quality Plan to FERC without first obtaining the approval of Ecology, the District would include specific reasons for doing so.

Environmental Analysis

Water quality conditions in the vicinity of the Project are very good, and meet (or comply with) State water quality standards with few exceptions. It is expected that implementation of water quality monitoring and management activities in the Water Quality Plan will ensure continued protection of water quality and compliance with State water quality standards over the term of the next license term.

E.6.2.3.3.2 Water Temperature Conditioning in OR-3

Issue

The Project maintains a minimum flow of 20 cfs in the bypass reach between Culmback Dam and the Diversion Dam (i.e., OR-3) by releasing water through valves at the base of Culmback Dam. Even though this release is relatively cold during summer (about 5 to

6°C), the water in the bypass reach can warm at a faster rate than water released at the Diversion Dam and Powerhouse. This faster rate of warming during summer has produced an occasional exceedence of the Core Summer Salmonid Habitat criterion of 16°C at the lower end of the bypass reach upstream of the Diversion Dam (RM 9.8). During the 2-year water quality study, the 7-DAD Max reached 16.6ºC for a 5 day period in July 2007 at the site above the Diversion Dam. In addition, as discussed in Section E.6.3.3, the release of relatively cold water from Culmback Dam during summer also appears to be a factor in lower productivity of resident fish and macroinvertebrates in the bypass reach.

Proposed Measure

The District proposes to implement a program to condition the temperature of the water released at Culmback Dam in order to provide a seasonally appropriate water temperature regime that would improve conditions for aquatic resources (including resident fish and macroinvertebrates) in the bypass reach between Culmback Dam and the Diversion Dam (i.e., Reach 3). In consultation with the ARC, the District would develop temperature conditioning performance standards for April through October in the bypass reach. The performance standards would be developed for points at the upstream end of the reach (where water is released) and the downstream end of the reach. These performance standards would be determined based on ranges of water temperatures that are suitable for aquatic resources (including resident fish and macroinvertebrates) as reported in the research literature.

The District would submit a Water Temperature Conditioning (WTC) Plan to FERC for approval within 180 days of issuance of the License. The WTC Plan would document how the District would implement a program to condition the temperature of waters released at Culmback Dam. The WTC Plan would include:

1. The preliminary operation plan for the conditioning of water released from Culmback Dam pursuant to the schedule for the Minimum Flow PM&E measure (as described Section E.6.2.3.2) to achieve temperature conditioning performance standards in the bypass reach;

2. The method and schedule for, and limitations upon, temperature conditioning of water releases;

3. The method, the locations, and the schedule for monitoring water temperature within the bypass reach and the response of aquatic resources (including resident fish and macroinvertebrates) to water temperature conditioning;

4. The method and schedule for adjusting the water temperature release schedule based upon temperature monitoring; and

5. The temperature conditioning program annual reporting and ARC consultation requirements.

The District would develop the WTC Plan in consultation with the ARC. The District would allow a minimum of 30 days for members of the ARC to comment and make recommendations before submitting the WTC Plan to FERC. When filing the WTC Plan with FERC, the District would include documentation of consultation; copies of comments and recommendations; and specific descriptions of how comments and recommendations from the ARC are accommodated by the District's plan. If the District does not adopt a recommendation, the filing would include the District's reasons based upon Project-specific information. Upon FERC approval, the District would implement the WTC Plan.

The District would implement the temperature conditioning program within the environmental limitations and physical constraints of the Project's existing pipe infrastructure. The District would make temperature sensor and control valve modifications, as necessary, to implement this program. The water release points at Culmback Dam would be the 10-inch cone valve, the hydro unit, and the 16-inch auxiliary release line. Blending ratios associated with this temperature conditioning program would be determined by temperature monitoring of Spada Lake, at the Culmback Dam water release points, at the downstream end of the bypass reach, and/or possible other suitable locations in OR-3. The temperature conditioning program would be implemented only when: (1) reservoir elevations are greater than 1,410 feet msl; (2) the reservoir is stratified (typically May through October); and (3) conditions at designated monitoring points in the reach would otherwise not be within temperature conditioning performance standards.

The District would monitor water temperatures in the bypass reach between Culmback Dam and the Diversion Dam (Reach 3) annually for the term of the License. The District would monitor water temperature on a daily basis for potential exceedence of state water quality criteria at the downstream section of the bypass reach. If monitoring indicates the potential for a possible exceedence (i.e., 7-DADMax greater than 16°C), the District would quantify the geographic extent of elevated temperatures and if warranted, incrementally increase the volume of cool water released from Culmback Dam. As discussed in Section E.6.3.3, the District also would monitor the biological response of aquatic resources (including resident fish and macroinvertebrates) to the temperature conditioning for the term of the License. The temperature conditioning monitoring would be done in consultation with the ARC.

Environmental Analysis

The Stream Segment Temperature Model (SSTEMP) (Bartholow 2002) was used to evaluate the effects of the WTC plan on water temperatures in OR-3. SSTEMP provided predictions of daily mean water temperatures by month for assumed releases from Culmback Dam with and without temperature conditioning. The resultant water temperatures predicted by the SSTEMP model (assuming a continuous instream flow release from Culmback Dam of 20 cfs) are summarized in Table E.6.2-11. The SSTEMP model results indicate that conditioned releases from Culmback Dam would raise daily mean water temperatures during summer from about 5.5 ºC to as much as 14 ºC in the bypass reach below Culmback Dam and from about 11.8 ºC to as much as 13.3 ºC above the Diversion Dam. As a result, the current unnaturally cold conditions in the bypass reach during summer would be warmed, particularly in the upper half of the bypass reach.

Table E.6.2-11 SSTEMP predictions of daily mean water temperatures by month below Culmback Dam and above the Diversion Dam under non-conditioned (existing) releases and conditioned (proposed) releases of 20 cfs from Culmback Dam.

Month	Flow (cfs)		Daily Mean Temperature (ºC) under Non-Conditioned (Existing) Releases		Daily Mean Temperature (ºC) under Conditioned (Proposed) Releases	
	Below Culmback Dam	Above Diversion Dam	Below Culmback Dam	Above Diversion Dam	Below Culmback Dam	Above Diversion Dam
April	20	87	4.0	6.9	4.0	6.9
May	20	84	5.0	9.0	6.5	9.2
Jun	20	58	5.0	10.4	8.0	10.8
July	20	35	5.5	11.8	10.0	12.6
August	20	27	5.5	11.4	14.0	13.3
September	20	31	5.5	9.5	14.0	11.4
October	20	57	5.5	8.5	8.7	9.3

With implementation of the WTC plan, it is expected that 7-DAD Max water temperatures in OR-3 would continue to typically be less than the 16°C criterion. The SSTEMP model provides predictions of mean daily water temperatures, but not 7-DAD Max water temperatures. However, correlations of mean daily and 7-DAD Max water temperatures from data collected in the summers of 2007 and 2008 indicate that 7-DAD Max water temperatures were less than the 16°C criterion when corresponding mean daily water temperatures were less than 14.4°C on average. The data further show that 7-DAD Max water temperatures were always less than the 16°C criterion when corresponding mean daily water temperatures were 13.3°C or less. SSTEMP model results indicate that conditioned releases from Culmback Dam would raise daily mean water temperatures to as much as 13.3ºC just above the Diversion Dam (Table E.6.2-11). Therefore, based on the SSTEMP model results, it is expected that 7-DAD Max water temperatures would be less than the 16°C criterion during summer under typical summer meteorological conditions (such as assumed in the model).

E.6.2.3.3.3 Maintain River Temperature within Stage I Range

Project Nexus

Project operations can affect seasonal water temperature patterns in the Sultan River downstream of Culmback Dam. Protecting Sultan River aquatic resources, such as salmon and steelhead production potential, requires water temperature management.

Proposed Measure

The District proposes to continue operating the Project in a manner that maintains water temperature in the Sultan River within the pre-Stage II range downstream of the Diversion Dam, as is described in Section E.6.2.2.2.1. In summary, the operational goal is to ensure that Sultan River temperatures are reasonably close to the pre-Project mean when the reservoir is stratified (the time that Project operations have water temperature control capabilities). The District specifically proposes to operate the Project power tunnel water withdrawal structure at Spada Lake to approximate to the fullest extent possible, within a band of 2°C, the daily mean of recorded pre-Project temperatures.

Environmental Analysis

Under proposed operating conditions, it is expected that Project effects on Sultan River water temperature would be similar to existing conditions (see Section E.6.2.2.2.1). The cooling pattern in summer and early fall (compared to Stage I) is expected to be maintained under proposed operations. Operational measures designed to comply with the 7-DADMax 16°C water quality criteria would result in either full compliance or would greatly reduce the frequency of criteria exceedence in OR-1, which currently is rare.

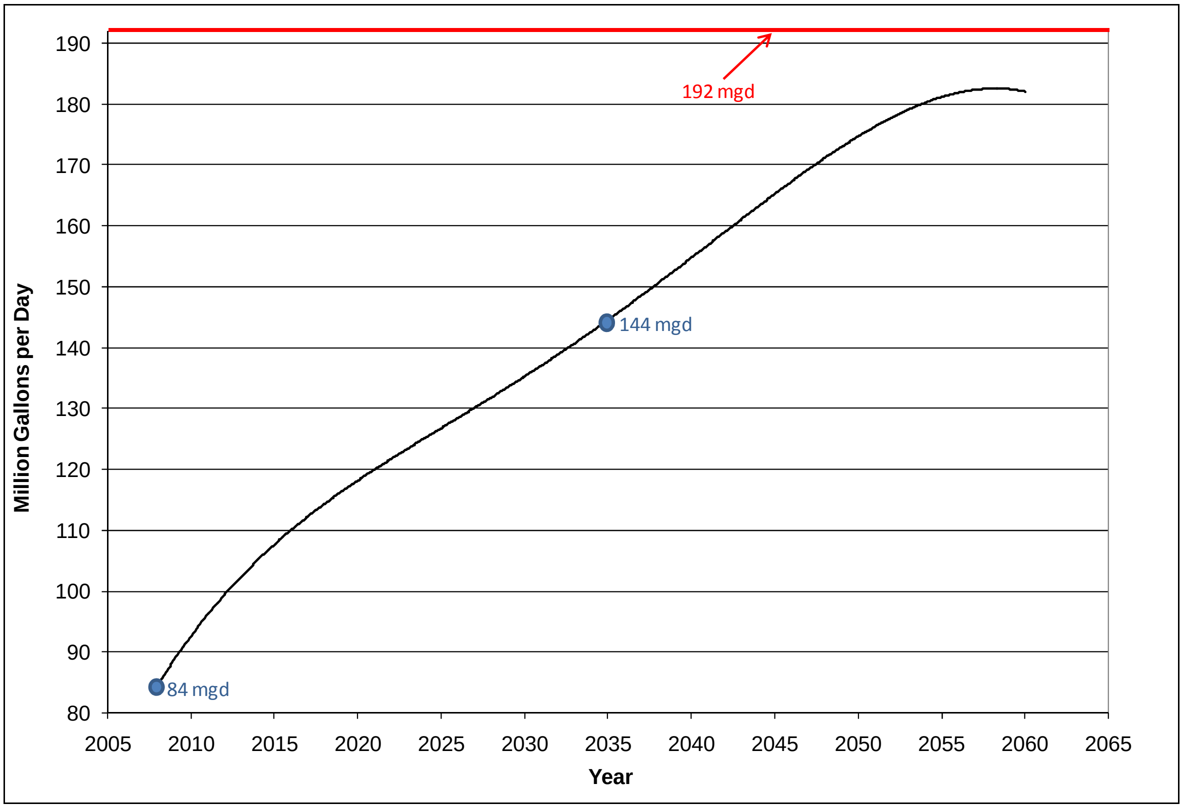
E.6.2.4 Cumulative Effects

The following sections evaluate the Project's cumulative effects on water quantity and water quality. As defined during scoping, the geographic scope for this analysis considers the Snohomish River basin, but focuses on the Sultan River basin.

E.6.2.4.1 Water Quantity

The City's Diversion Dam, Lake Chaplain and its water storage, treatment and supply system are not proposed to be a part of the licensed Project. Project facilities are incidentally used to deliver water supply to the City's reservoir (Lake Chaplain) in accordance with an agreement between the District and the City. The Jackson Project was designed and is operated to accommodate and assure the continued viability of the City's pre-existing municipal water supply rights and system; accordingly, the City's water rights and withdrawal facilities and operations represent a part of the environmental baseline of the watershed.

The City projects that water demand will increase to about 192 mgd in 2060 (Figure E.6.2-18), which corresponds roughly to the span of a Project license. This increase in demand would cumulatively affect water quantity in the Sultan River basin. Increased water withdrawals by the City directly affects the total Sultan River subbasin water budget and the amount of water that could be allocated to other beneficial uses. The cumulative effect of increasing water demand from 84 mgd to 192 mgd equates to about 108 mgd or 121,000 acre-feet of water annually that could not be allocated to other water resource demands, such as for minimum stream flows (beyond the levels proposed by the District). In other words, the average yearly Spada Lake subbasin water budget would decrease by about 22 percent[15] as the City's demand increases from 84 to 192 mgd (130 cfs to 297 cfs, respectively).



(Source: City of Everett 2008 Comprehensive Water Plan).

Figure E.6.2-18 City of Everett projected water supply demand with 0.5 percent annual conservation.

For the purpose of modeling water resource effects over the course of the next license, District staff analyzed various operating scenarios for the current water demand of 84 mgd, a mid-license water demand of 144 mgd, and 192 mgd, which is projected into the future about 10 years beyond the potential term of a 50-year license (Figure E-6.2-18). This demand curve assumes that conservation measures would be implemented, which would result in 0.5 percent annual water use reduction. However, the analysis does not assume any additional reduction in City water demands during drought conditions. Therefore, the following analysis of cumulative effects represents a "worst case" scenario. If the City were to implement additional conservation measures during droughts, effects would be reduced.

One of the City's concerns in managing the water supply is to protect the "safe yield" of the reservoir. The safe yield is defined by the City as the demand level that could be relied on without more than a 2 percent risk of failure. Translated into terms relative to this analysis, this means the chance of Spada Lake going dry given the City's demand would not be greater than about twice in a 109-year period. The City's analysis of their "safe yield" under the current operating scenario defines demand as 200 mgd which

[15] (Projected Demand – Current Demand)/Average Annual Spada Lake inflow = (297-130)/768.5*100

greatly exceeds their projected demand by many years beyond a new license term of 50 years (City of Everett's 2008 Comprehensive Water Plan). Therefore, 192 mgd was used to model the highest water demand scenario for this analysis.

E.6.2.4.1.1 Influence of Increased City Water Supply on Spada Lake under Current Operations

Following current rule curves and minimum stream flow requirements, as the City's water supply demand increases, Spada Lake would be drawn lower each year (always in the fall) given the same hydrology (Figure E.6.2-19). For the 84 mgd demand, the variation in yearly minimum reservoir levels shows there is little chance of Spada Lake falling below elevation 1,380 feet msl over the 109 year modeled period (the lowest elevation was 1,386 feet msl in 1987-1988). With a 144 mgd demand, Spada Lake would fall below elevation 1,380 feet msl in 6 of 109 years, or less than 6 percent. With a 192 mgd demand, Spada Lake would fall below 1,380 feet msl in 32 of 109 years (about 29 percent of years).

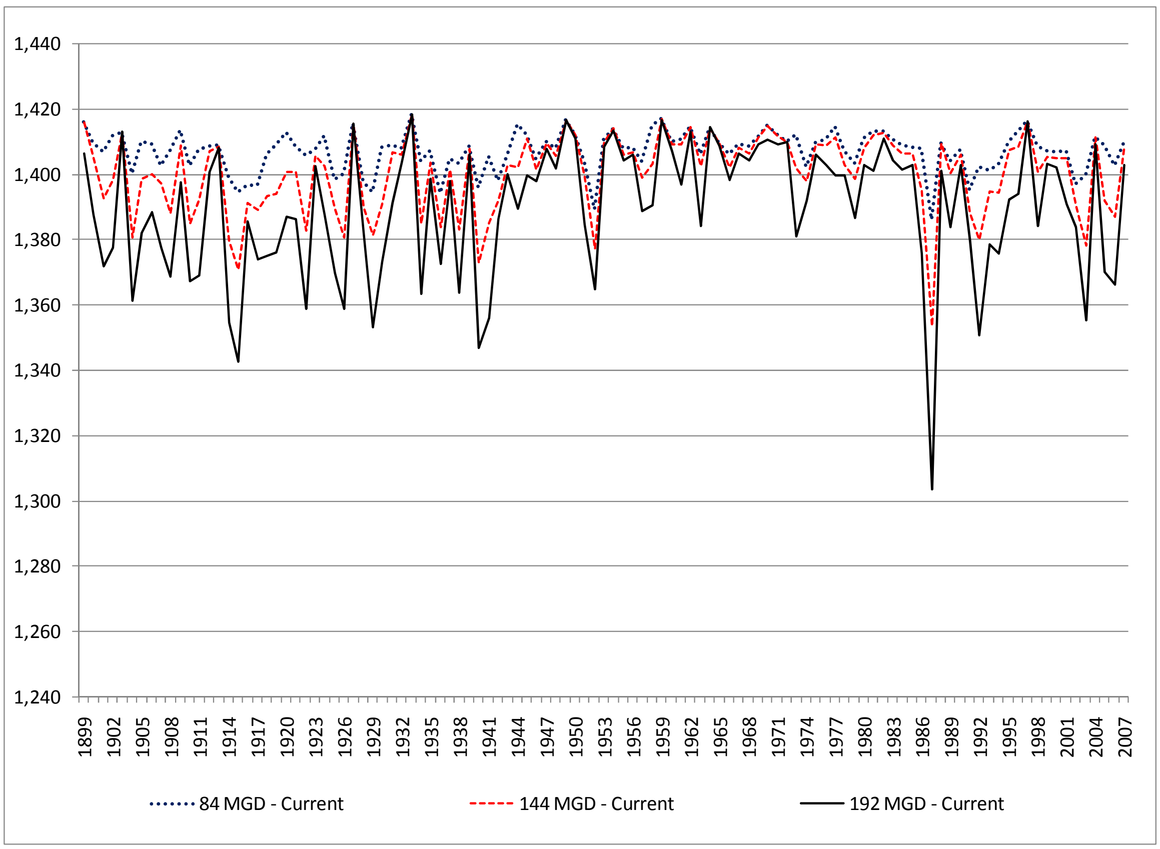


Figure E.6.2-19 Spada Lake annual minimum elevation over 109 modeled years for three water supply demand scenarios under <u>current</u> license rule curves and current license minimum stream flow requirements.

E.6.2.4.1.2 Effects of Increased City Demand and Proposed Increased Minimum Stream Flows on Spada Lake and Sultan River Instream Flows

Stakeholders wish to improve minimum stream flow conditions for aquatic resources, such as increased minimum stream flows to increase side channel rearing habitat for juvenile salmon and steelhead and to increase overall spawning and rearing habitat. In addition, stakeholders wish to maintain Project control of flow release points and water temperatures (when Spada Lake is stratified) to meet state water quality standards and to benefit aquatic resource productivity, all while maintaining the City's water supply and incidental flood control. The District supports improved minimum stream flows for aquatic resources and proposes to increase minimum stream flows downstream of the Powerhouse (OR-1) by at least 50 percent. This would increase aquatic habitat during critical time periods for salmon and steelhead (as discussed in Section E.6.3.3.1.1).

Balancing increased minimum stream flow requirements with increased water supply needs, while maintaining beneficial Project controls, would involve water budget trade-offs. For example, modeling suggests that increasing minimum stream flows alone and revising the rule curves to reduce impacts to fall Chinook spawning, would not jeopardize the City's water supply, but would cause environmental effects on a more frequent basis when compared to existing conditions. The primary effect would be increased incidents and duration when the reservoir level drops below elevation 1,380 feet msl (Figure E.6.2-20), resulting in the loss of beneficial water temperature control during the Chinook spawning period. Under proposed operations, modeling indicates the reservoir did not drop below elevation 1,380 feet msl, but dropped below this elevation in 3 of 109 years at the current demand of 84 mgd. However, as demand increases to 144 mgd, the reservoir would drop below elevation 1,380 feet msl in 28 of 109 years, and in 53 of 109 years as City water demand increases to 192 mgd.

Lower reservoir elevations also would increase the frequency of reservoir level elevation triggers reducing flows in OR-1 and OR-2, although these "lowered" minimum stream flows are the same or higher than current minimum stream flow requirements depending on the season. During severe drought years under the 192 mgd water supply demand scenario and assuming that the City does no demand management, modeling indicates that Spada Lake would be totally drained (Figure E.6.2-21), which would also have severe consequences to the resident trout population within Spada Lake.

In summary, as the City water demand increases beyond current levels, the remaining water budget decreases, and water for instream needs also decreases. Given the Project's operational constraints, particularly the limited ability of the reservoir to capture runoff during peak flows, Project operations cannot be designed to completely mitigate effects of increased City water demand over the long term. As demand increases, minimum stream flow triggers would be implemented more frequently, the reservoir would be drawn down longer and further each year, the incidents of Spada Lake levels falling below elevation 1,380 feet msl each year would increase, and the chance of Spada Lake totally draining during a severe drought (assuming no water supply demand management) also would increase.

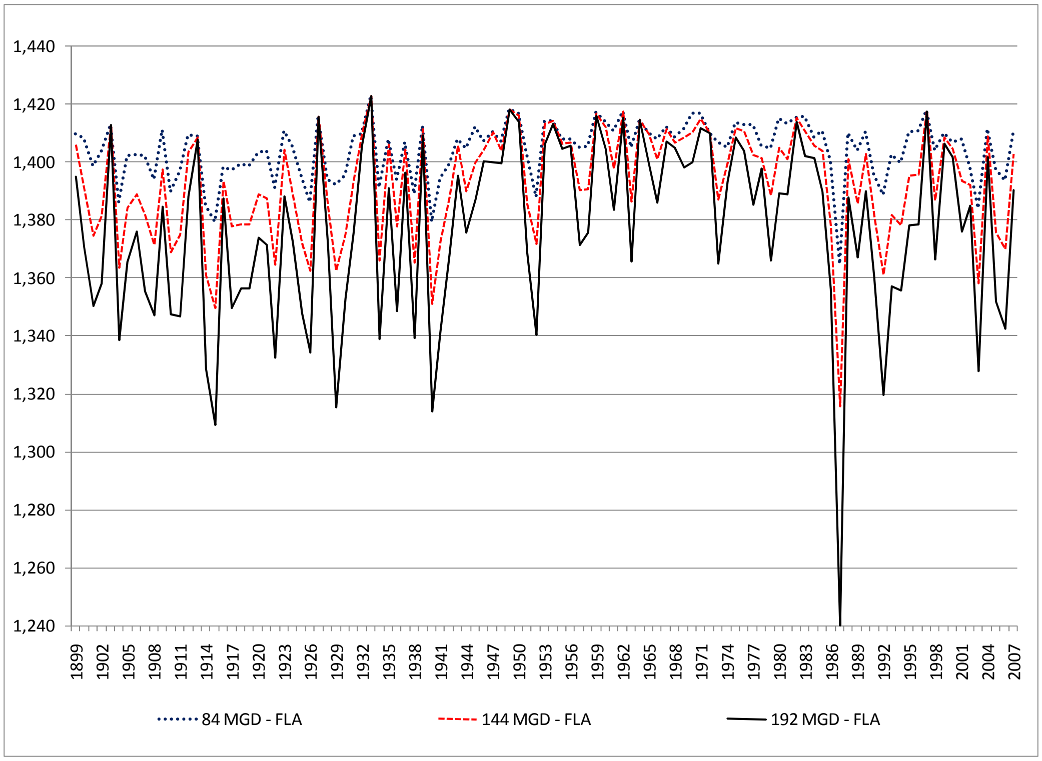


Figure E.6.2-20 **Spada Lake annual minimum elevation over 109 model years under proposed operations for current and future water supply demand scenarios.**

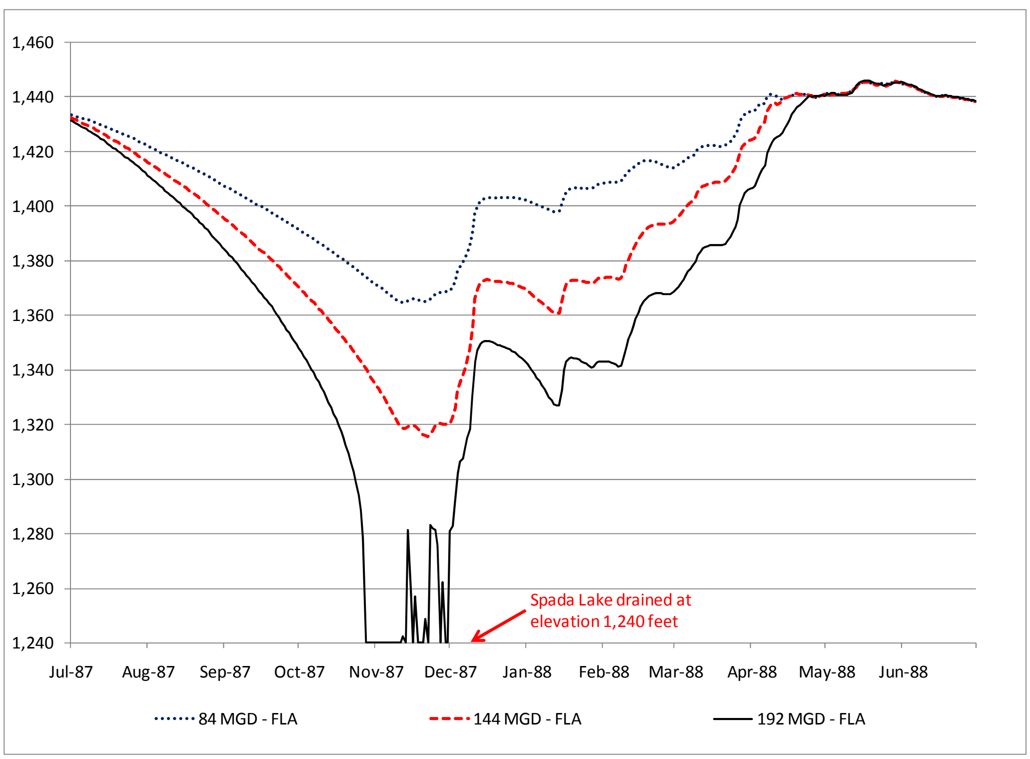


Figure E.6.2-21 **Spada Lake response to 1987-1988 drought conditions for three water supply scenarios under proposed operations.**

The three figures shown below (Figures E.6.2-22, E.6.2-23, and E.6.2-24) compare existing operations and proposed operations for "wet", "average", and "dry" modeled water years for reaches OR-1, OR-2, and OR-3, respectively. The data presented in these figures consider the proposed operational scenario, cumulative effects of proposed PM&Es, and increased City water demand.

In general, as water demand increases above 84 mgd, flows in the summer and early fall decrease in OR-1 in a wet (Figure E.6.2-22) and average (Figure E.6.2-23) water year, but particularly in a dry year where flows are reduced in the winter as well (Figure E.6.2-24).

In OR-2, as water demand increases, flows are nearly the same in a wet (Figure E.6.2-22) and dry year (Figure E.6.2-22), but increase in an average year in the fall (Figure E.6.2-23).

In OR-3, as water demand increase, flows in OR-3 increase in the summer, fall and early winter in wet, average, and dry years (Figures E.6.2-22, E.6.2-23, E.6.2-24) due to the increased frequency of the reservoir being drawn down below elevation 1,380 and the need to release water from the base of Culmback Dam to meet City water diversion needs and minimum stream flow requirements in OR-1 and OR-2.

E.6.2.4.2 Water Quality Cumulative Effects Analysis

The Sultan River basin, in which the Project is located, is a relatively remote watershed characterized by rugged forested terrain. The Sultan River basin has been protected as the source of the City's municipal water supply since 1917. This watershed protection requirement has restricted the range of recreational and other activities that occur in the Project area, and in a large portion of the upper Sultan River basin. Over time, the land use activities in the basin have shifted from commercial timber production to a focus on resource conservation, wildlife habitat management, recreation and watershed protection.

The focus on watershed protection and natural resources management in the Project area is expected to continue over the term of the new license 30 to 50 years into the future. Under these conditions, the overall water quality in the Sultan River in the vicinity of the Project is expected to remain very good, with dilute dissolved solids and ions content, and free from pollutants or contaminants.

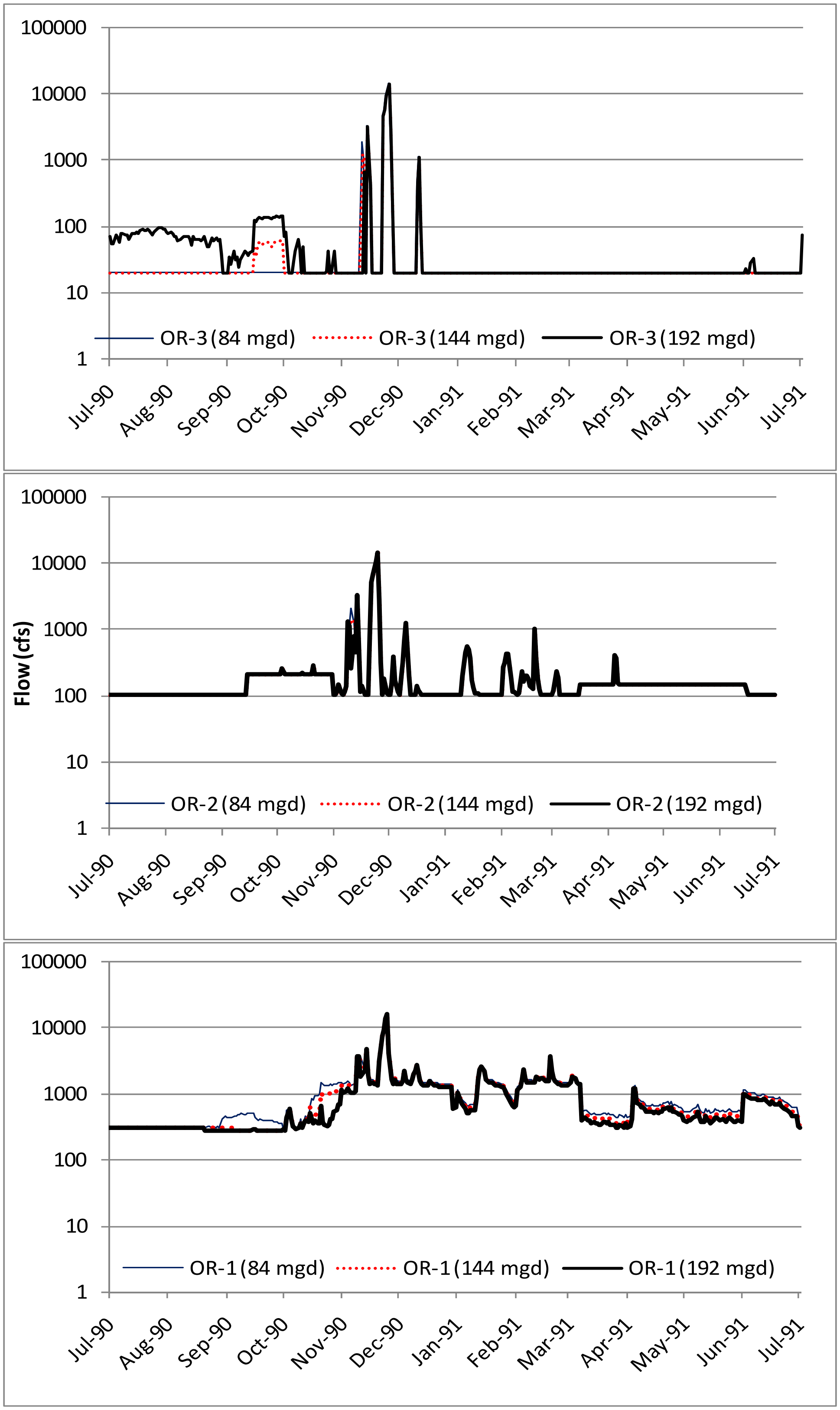


Figure E.6.2-22 Daily flows in OR-1, OR-2 and OR-3 during a wet year (1990-1991) under proposed operating conditions at varying City water demands (log scale on Y axis for clarity).

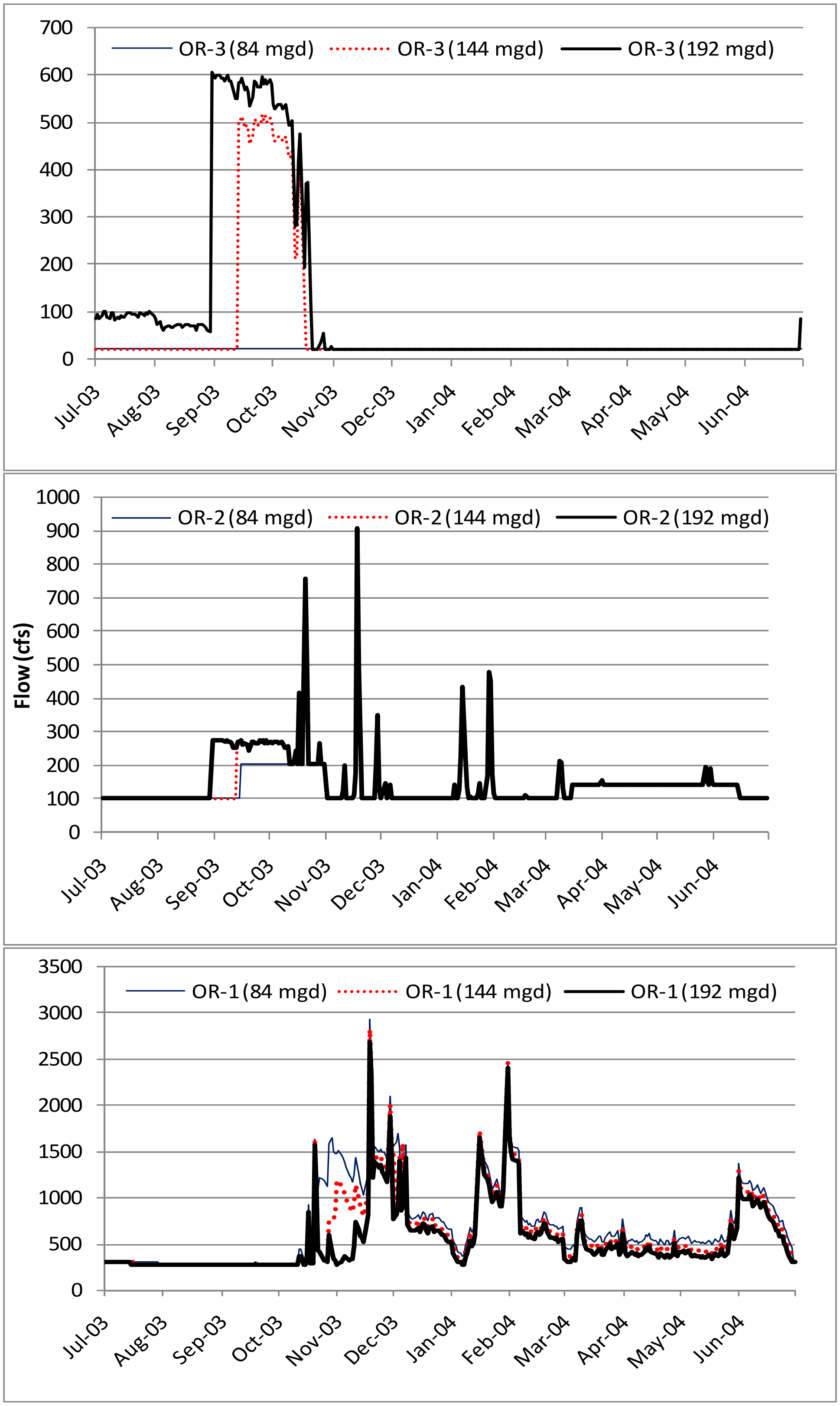


Figure E.6.2-23 Daily flows in OR-1, OR-2 and OR-3 during an average year (2003-2004) under proposed operating conditions at varying City water demands.

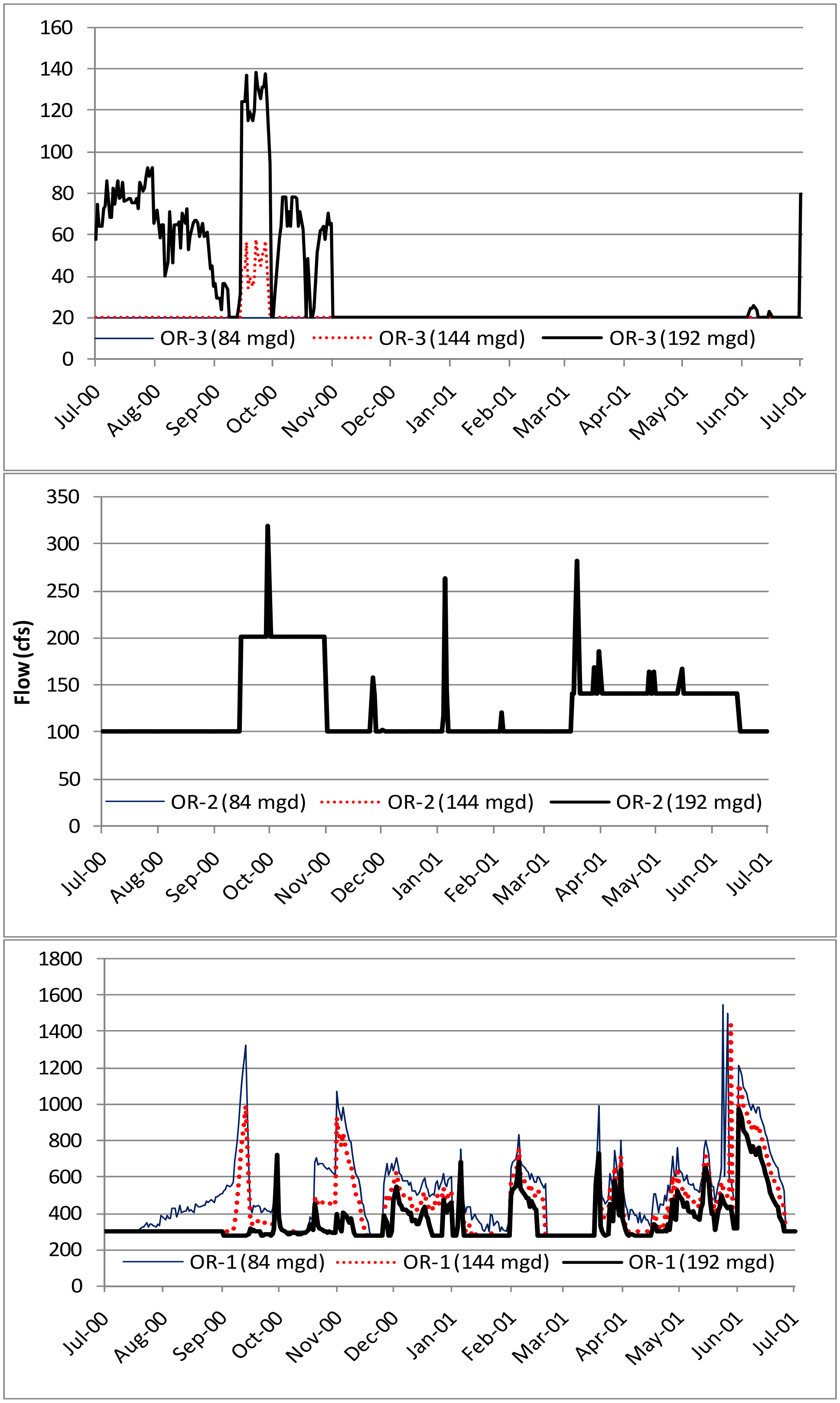


Figure E.6.2-24 **Daily flows in OR-1, OR-2 and OR-3 during a dry year (2000-2001) under proposed operating conditions at varying City water demands.**

Project facilities are used to deliver water supply to the City's reservoir (Lake Chaplain) in accordance with an agreement between the District and the City. The use of Project facilities to deliver water supply to Lake Chaplain will continue over the term of the new license. The City estimates that water demand will increase from the current demand of 84 mgd to a demand of about 192 mgd by 2060. As discussed above in section E.6.2.4.2, this increase in demand would cause minimum flow triggers to be implemented more frequently, and would increase the odds in a given year that Spada Lake levels would fall below elevation 1,380 feet msl – the reservoir level below which water cannot be withdrawn through the power tunnel. In such instances, minimum flow releases downstream of Culmback Dam for aquatic resources would need to be met by releases through valves at the base of Culmback Dam. During late summer-early fall (when minimum Spada Lake levels would occur), such releases would be unnaturally cold and could lower daily maximum water temperatures by up to about 6 or 7°C[16] in the Sultan River downstream of Culmback Dam. Such reduction in lake levels also would temporarily dewater additional shoreline area around the lake during the drawdown period, which could potentially cause increases in turbidity in Spada Lake if erosion occurs from exposed shoreline areas (such as during a relatively intense rainfall event).

E.6.3 Aquatic Resources

E.6.3.1 Affected Environment

The Sultan River provides spawning and rearing habitat for numerous anadromous fish species including Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), pink (*O. gorbuscha*), and chum (*O. keta*) salmon; steelhead (*O. mykiss*); and coastal cutthroat trout (*O. clarki*). Bull trout (*Salvelinus confluentus*) have not been observed spawning in the Sultan River; however, they are known to use the river as rearing/foraging habitat. Each of these species has access to the Sultan River from its mouth to the City of Everett's Diversion Dam, a man-made barrier to upstream migration located at RM 9.7.[17] Culmback Dam (RM 16.5) is located upstream of the historical anadromous zone (Ruggerone 2008).

Under existing conditions, Chinook and coho salmon, and summer and winter-run steelhead spawn and rear in the entire river reach downstream of the Diversion Dam (Table E.6.3-1). Chum and pink salmon spawn primarily in the lower 3 miles of the

[16] For example, water temperature in the hypolimnion of Spada Lake during late summer is about 6 °C. Under existing operating and temperature control conditions, maximum daily water temperature in the Sultan River just below the Diversion Dam is about 12 to 13 °C in late summer-early fall (i.e., based on August and September data). If Spada Lake levels dropped below elevation 1,380 feet, all flows from Culmback Dam would be released from the base of Culmback Dam rather than withdrawn through the power tunnel, resulting in much larger flows in the bypass reach than compared with typical operating conditions. These larger flows would have a greater thermal capacity (i.e., resistance to natural warming) and move at a faster travel time than the typical lesser bypass reach flows. As such, natural warming may not raise the water temperature much during transit of these larger flows through the reach. If so, water temperatures of the river at the Diversion Dam could be about 6 to 7°C in late summer-early fall under these potential conditions, compared to about 12 to 13°C in late summer-early fall under existing operating and temperature control conditions – a decrease of up to about 6 to 7°C.

[17] The current Diversion Dam has been in place since 1930.

Sultan River; however, pink salmon have been observed upstream to RM 7.5. Other species found in the Sultan River include Pacific lamprey (*Lampetra tridentata*), mountain whitefish (*Prosopium williamsoni*), sculpin (*Cottis spp.*), suckers (*Catostomus spp.*), dace (*Rhinichthys* spp.), and three-spine stickleback (*Gasterostreus aculeatus*).

Table E.6.3-1 Resident and anadromous fish species present in the Sultan River basin.

Species	Distribution in the Sultan River Basin		
	Sultan River (Mouth to Diversion Dam)	Sultan River (Diversion Dam to Culmback Dam)	Spada Lake and its Major Tributaries
Chinook Salmon	X		
Coho Salmon	X		
Pink Salmon	X		
Chum Salmon	X		
Steelhead/Rainbow Trout	X	X	X
Bull Trout/Dolly Varden	X		
Cutthroat Trout	X	X	X
Pacific Lamprey	X		
Mountain Whitefish	X	X	
Brook Trout			X
Brown Bullhead			X
Sculpin spp.	X	X	
Suckers spp.	X		X
Dace spp.	X		
Three-spine Stickleback	X		

Spada Lake, the reservoir located upstream of Culmback Dam, supports resident rainbow trout, cutthroat trout, and potential hybrids of these two species. Although extremely rare, brook trout (*Salvelinus fontinalis*), a non-native char, have been captured in Spada Lake and in Williamson Creek. Brown bullhead (*Ameiurus nebulosus*) were introduced into Spada Lake by uncertain means around 1970 and the species is now found in all areas of the reservoir. In addition to these species, largescale suckers were observed in Spada Lake for the first time during gill net sampling in 2007 (Meridian Environmental and Shuksan Fisheries Consulting 2008).

During Project relicensing, the District completed 12 aquatic resource studies designed to describe the current distribution of anadromous and resident species within Project-area waterbodies and to evaluate the quality and quantity of available habitat potentially affected by Project operations. In the following sections, we briefly describe the physical features, aquatic habitat, and aquatic biota in the mainstem Sultan River and Spada Lake. For additional information relating to ESA-listed fish species and their designated critical habitat, see Section E.6.6. A general description of existing Project effects on aquatic resources in the Sultan River basin is presented in Section E.6.3.2.

E.6.3.1.1 Aquatic Habitat in the Sultan River

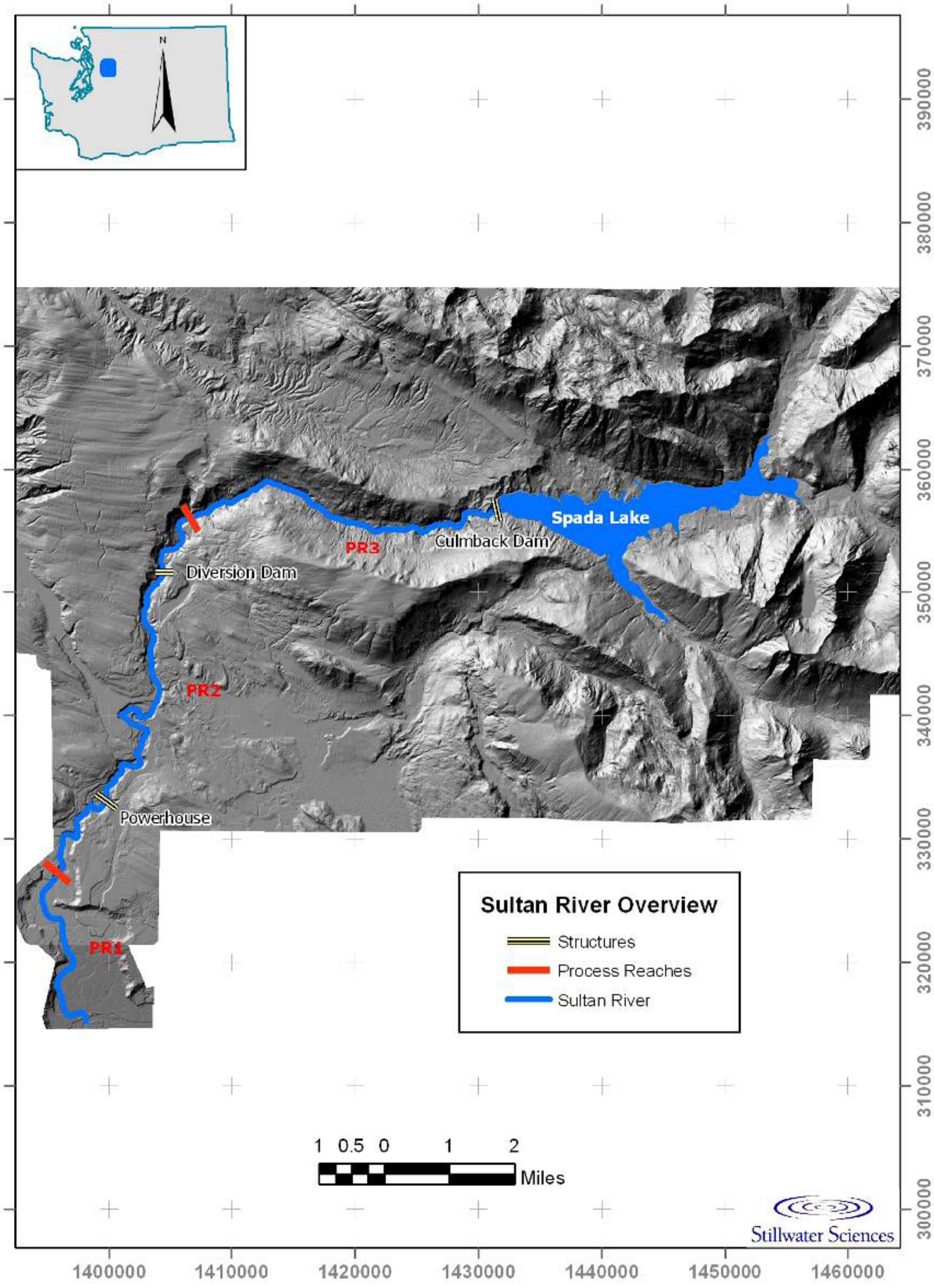
The following description of aquatic habitat in the Sultan River is derived from field surveys conducted in 2007, and unless otherwise cited, is summarized from R2 Resource Consultants (2008b) and Stillwater Sciences and Meridian Environmental (2008a).

The Sultan River from Culmback Dam to its confluence with the Skykomish River flows through three distinct process reaches (PR). The lowermost process reach (PR-1) is a low gradient alluvial valley that includes a broad floodplain (RM 0 to 3) (Figure E.6.3-1). A terrace-bounded valley process reach (PR-2) extends from RM 3 to RM 11, and a relatively high gradient V-shaped valley reach (PR-3) extends from RM 11 to RM 16.5. As described in Section E.6.2.1.1.2, the lower Sultan River can also be divided into three operational reaches (OR-1, OR-2, and OR-3) demarcated by physical structures that regulate flow (i.e. the Powerhouse, Diversion Dam, and Culmback Dam), and therefore, aquatic habitat availability in the lower Sultan River. Because Project water releases to these reaches largely dictate habitat quantity within the lower Sultan River, habitat is summarized in this section by operational reach and not by habitat process reach.

Downstream of Culmback Dam (RM 16.5), the Sultan River flows through a deep gorge for nearly 14 miles, which includes both reaches OR-3 and OR-2. The steep side slopes above the channel are densely forested with conifer and mixed deciduous growth. The river channel is relatively high gradient and confined, containing numerous cascades and rapids separated by short pool-riffle stretches (Figure E.6.3-1). Much of the streambank is sheer rock face or large rock cuts (Williams et al. 1975). Near RM 3, the Sultan River emerges from the canyon reach onto a broad, relatively flat valley floor containing intermittent stands or strips of deciduous trees, underbrush, and some mixed conifers. The river channel in this reach has a moderate gradient, dominated by glide and low gradient riffle habitat, with a number of split channel sections. All side-channel habitat is contained within the lowermost operational reach (OR-1).

The relative volume of LWD is greatest in the middle section of the river (OR-2), closely followed by OR-3. Wood volume is lowest (less than half of that found in OR-2) in the lower river (OR-1) where the channel is unconfined and wide. LWD does not appear to be a significant factor in terms of pool formation and is largely positioned along the channel margins. Wood in this position does not obstruct flow and therefore contributes little to channel and habitat complexity. The main pool-forming mechanism is landslides and resulting debris dams in the 14-mile-long canyon.

The summary below focuses on the type and relative amount of habitat within each operational reach. Flows are described in Section E.6.2.1.1.2 and the effects of Project minimum flows on aquatic habitat quantity is presented in Section E.6.3.2.1.3.

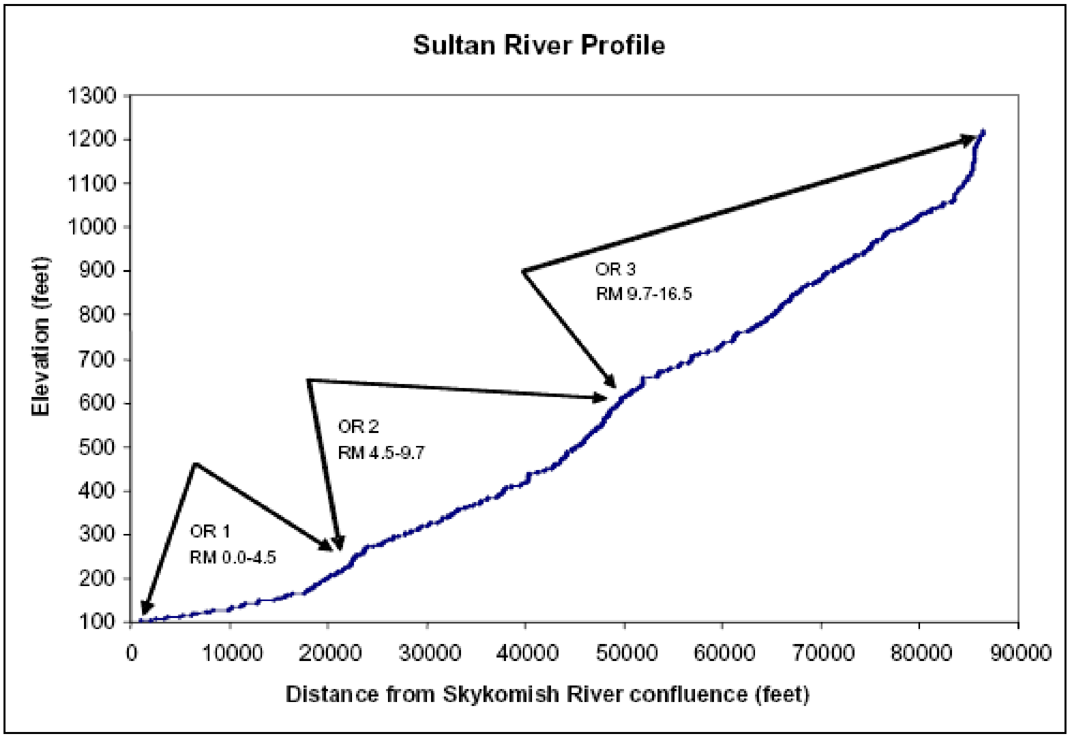


(Source: Stillwater Sciences and Meridian Environmental 2008a).

Figure E.6.3-1 Overview of the Sultan River basin process reaches and operational reaches (demarcated by the Powerhouse, Diversion Dam and Culmback Dam).

E.6.3.1.1.1 Operational Reach 3

OR-3 (the Project bypass reach) is best described as a high gradient, highly confined bedrock gorge characterized by higher rates of sediment transport compared to downstream reaches. The channel is approximately 6.8 miles long and gradients range from 0.7 to 13.7 percent, averaging 1.6 percent. Channel gradient becomes progressively steeper in upper portions of the reach, with the highest gradient near Culmback Dam (Figure E.6.3-2).

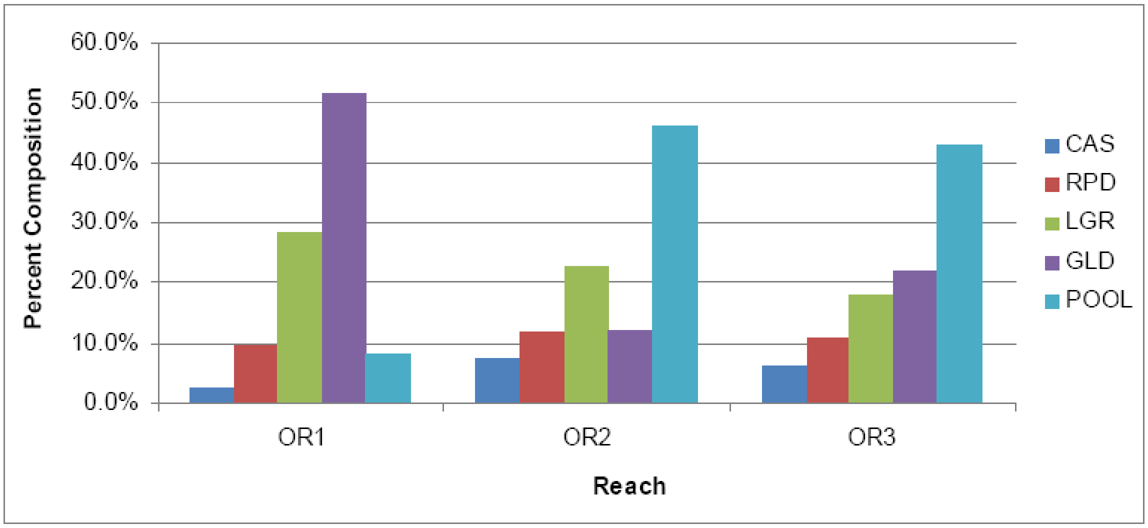


Source: Stillwater Sciences and Meridian Environmental 2008b

Figure E.6.3-2 Profile of Sultan River channel gradient from the confluence with the Skykomish River upstream to Culmback Dam.

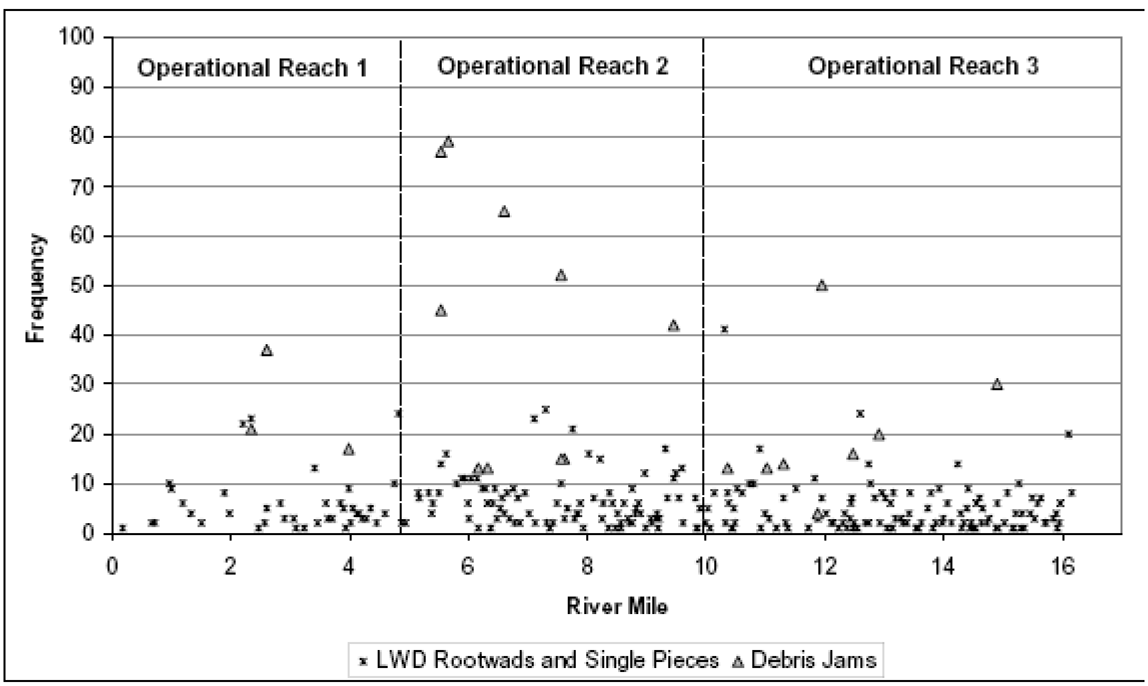
Aquatic habitat within OR-3 is mostly pool and glide habitat types (65 percent) (Figure E.6.3-3). Most of the pool habitat units (38 of 45) are controlled by bedrock formations. Channel substrate is generally coarse with boulder, bedrock, cobble, and large gravels as the dominant substrates. Due to safety concerns, the 0.7-mile reach of OR-3 below Culmback Dam was not examined during the 2007 survey and is therefore not included in the habitat type percentages.

Active channel width in OR-3 averaged approximately 50 feet. Main channel pools averaged 263 feet in length. Cascades averaged 140 feet in length. Glides and low gradient riffles averaged 215 and 250 feet in length, respectively. Islands were rare, likely reflecting the limited tendency of gravel deposits and vegetation to accumulate in this reach that is subject to scouring flood flows. Eight LWD jams were found within OR-3. A total of 550 pieces of LWD were noted in OR-3, but only 112 individual pieces were characterized as over 2 feet in diameter. LWD frequency was 102 pieces per mile (Figure E.6.3-4).



CAS=cascade, RPD=rapid, LGR=low gradient riffle, GLD=glide
Source: Stillwater Sciences and Meridian Environmental 2008b

Figure E.6.3-3 Composition of habitat types by operational reaches of the Sultan River.



Debris jam frequency value indicates the number of individual pieces in each jam.
(Source: Stillwater Sciences and Meridian Environmental 2008b

Figure E.6.3-4 Distribution and frequency of surveyed LWD within the Sultan River downstream of Culmback Dam.

E.6.3.1.1.2 Operational Reach 2

OR-2 is approximately 5.4 miles long and is largely confined within a narrow, deep canyon with channel gradients ranging from 0.7 to 3.4 percent. OR-2 was characterized by frequent main channel pools separated by numerous low gradient riffles. Habitat composition is primarily pools (45.9 percent) and low gradient riffles (22.7 percent) (Figure E.6.3-3). More than two-thirds (43 of 60) of the pool habitat units were controlled by bedrock and boulder substrates. Channel substrates were primarily boulder, bedrock, cobble, and large gravels. Active channel width averaged nearly 70 feet. Main channel pools averaged 318 feet long. On average, low gradient riffles were 230 feet long. Glides and rapids averaged 190 and 201 feet long, respectively.

Of the 10 LWD jams found in OR-2, two were notably large (each containing nearly 80 pieces) with a total of 586 pieces of woody debris (Figure E.6.3-4). Only 55 individual pieces were characterized as over 2 feet in diameter. LWD frequency was 196 pieces per mile in OR-2.

On December 11, 2004, a landslide occurred within a narrow canyon segment of OR-2 just downstream from Marsh Creek at RM 7.6. The landslide, referred to as the Marsh Creek landslide, temporarily blocked or reduced the upstream passage of adult anadromous salmonids. Since then, the characteristics and geometry of the landslide have changed and currently allow some fish passage. Ruggerone (2008) suggests that steelhead, Chinook and coho salmon could potentially swim through the cascade created by the landslide when minimum flows are about 107 cfs. Analysis indicates that pink and chum salmon are unlikely to be able to pass through this area. Ruggerone (2008) concluded:

- The present configuration of the Marsh Creek cascade appears to block the migration of most Chinook salmon as evidenced by the presence of Chinook below the slide when flows were low to moderate and favorable to passage (105 to 165 cfs and above), but absent upstream.
- Summer steelhead have the greatest opportunity to pass the Marsh Creek cascade because they encounter the slide under favorable passage conditions during their upstream migration period. Although the cascade may hinder summer steelhead migration, it is likely that most are able to eventually negotiate the cascade in its present configuration.
- Many winter steelhead are likely to negotiate the cascade, but additional observations of spawning steelhead during spring are needed for verification.
- It is likely that the Marsh Creek cascade is a modest impediment to coho salmon, but some coho pass above the cascade.
- Pink and chum salmon are unlikely to pass over the cascade.

- Significant changes occurred at the Marsh Creek cascade following high flow events in November 2006 and March 2007. Additional change is possible at flows exceeding 3,500 cfs.
- The right bank cliff above Marsh Creek cascade, which rises vertically approximately 200 feet, remains unstable. It is probable that another large landslide will occur in the Marsh Creek area and that fish migration will be further affected until high flows remove soil, boulders, and large wood.

E.6.3.1.1.3 Operational Reach 1

OR-1 is approximately 4.3 miles long (as calculated by field measurement). The uppermost 1.6 miles are deeply incised and largely confined within a bedrock canyon. Widths in this section range from 40 to 160 feet and channel gradients range from 0.7 to 2.9 percent (Figure E.6.3-2). The lower 2.7 miles of the reach are largely unconfined within a broad floodplain and a number of split channel sections have formed. Channel gradients range from 0.2 to 0.7 percent. Active channel widths range from 60 to over 200 feet.

Aquatic habitat within OR-1 was comprised mostly of glide (51.7 percent) and low gradient riffle types (28.4 percent) (Figure E.6.3-3). Glides and low gradient riffles averaged 463 and 295 feet in length, respectively. Channel substrate in the lower portion of OR-1 was predominately large and small cobble, coarse gravel, and boulder. The number of LWD pieces was lower per mile than the two upstream reaches; 35 individual pieces over 2 feet in diameter were identified and the frequency of LWD was 80 pieces per mile.

There are three major (over 1,000 feet long) and several minor side channels within OR-1. Only these three large side-channels support unrestricted fish access (R2 Resource Consultants 2008b). The total length of all side-channel habitats is approximately 0.9 miles and accounts for 4.7 percent of the length of all riverine habitat surveyed. Side-channel habitat was composed nearly equally of glides (54 percent) and low-gradient riffles (46 percent).

E.6.3.1.2 Anadromous Fish Populations

E.6.3.1.2.1 Chinook Salmon

<u>General Life History and Habitat Requirements</u>

Throughout their range, Chinook salmon exhibit a variety of life histories. Differences exist in age at seaward migration; freshwater, estuarine, and ocean residence; and in age and season of spawning migration (Healey 1991, Myers et al. 1998). Most of this variation is exhibited in two distinct behavioral forms commonly referred to as stream-type and ocean-type (Healey 1991). Stream-type Chinook rear in freshwater for a year or more before migrating to sea, perform extensive offshore migrations, and return to their natal river in spring or summer, several months prior to spawning. Ocean-type Chinook typically migrate to sea in their first year of life, only a few months after emergence, remain in nearby coastal areas, and normally return to their natal river in the late summer or fall, a few days or weeks before spawning. Ocean residence for both stream-type and ocean-type Chinook usually ranges from 1 to 6 years; however, a small proportion of yearling males, called "jacks" mature in freshwater or return to freshwater after 2 to 3 months in saltwater (Myers et al. 1998). Chinook salmon in the Puget Sound Evolutionarily Significant Unit (ESU) typically exhibit an ocean-type life history; however, a number of spring-run Chinook salmon populations in the ESU include a high proportion of yearling smolt emigrants.

Generally, ocean-type Chinook prefer to spawn in the middle and lower mainstem areas of large rivers (Healey 1991). Often, the preferred spawning sites are located near deep pools and in areas with abundant instream cover. Adequate spawning area (abundant clean gravel) and sub-gravel flow are very important in the choice of redd (gravel spawning nest) sites. Successful egg incubation depends on a variety of extragravel and intragravel physical, chemical and hydraulic variables (Bjornn and Reiser 1991). In general, incubating eggs require a relatively stable stream channel (with minimal bedload movement), adequate intragravel percolation rates (i.e., limited siltation), relatively high DO concentrations, and adequate water depth above the redd (Healey 1991).

While rearing in freshwater, juvenile Chinook are normally associated with low gradient, meandering, unconstrained stream reaches, and often move into side channels, beaver ponds, and sloughs for over-wintering habitat. As they grow, submerged and overhead cover in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food and shade and protect juveniles from predation (Healey 1991). When adult Chinook return to spawn, they often rely on deep pools for resting. These pools provide an energetic refuge from river currents, a thermal refuge from high summer and autumn water temperatures, and protection from potential predators (Berman and Quinn 1991).

Local Stock Information

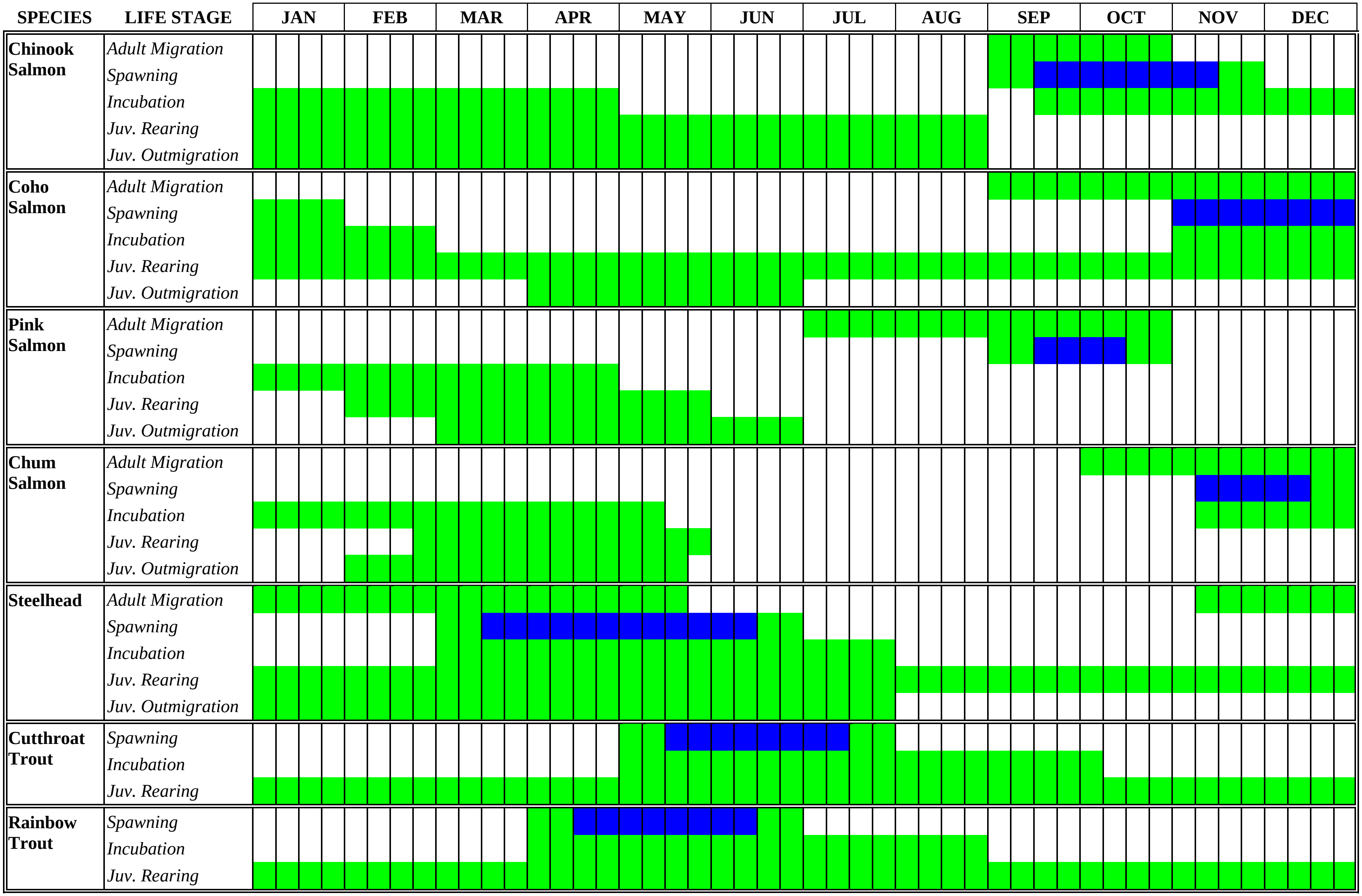
The WDFW recognize 26 independent populations of Chinook salmon in the Puget Sound region (WDFW 2002a). Two of these, Skykomish Chinook and Snoqualmie Chinook, spawn and rear in the Snohomish River and its major tributaries (Haring 2002). The naturally spawning Chinook salmon found in the Sultan River are the Skykomish Chinook stock (WDFW 2002a). Skykomish Chinook typically spawn from September through November in the mainstem Skykomish and Snohomish rivers; and in the Wallace, Sultan and Pilchuck rivers, and Bridal Veil, Woods, Quilceda, and Elwell creeks. Limited spawning also takes place in the North Fork and South Fork Skykomish rivers.

Skykomish Chinook usually begin entering the Sultan River in early September. Peak spawning occurs in early October; however, spawning individuals have been documented as late as the last week in November (Figure E.6.3-5 and E.6.3-6). Fry emerge from the gravel as early as January, with peak emergence occurring in March. Following emergence, fry disperse and rear along the stream margins for up to several months before migrating downstream. Evidence in the Sultan River suggests that the majority of the Chinook fry rear in the stream margins for several months, and migrate downstream by June (CH2M Hill 2005).

Source: Snohomish County PUD 2005

Figure E.6.3-5 Spawning Chinook salmon in lower Sultan River.

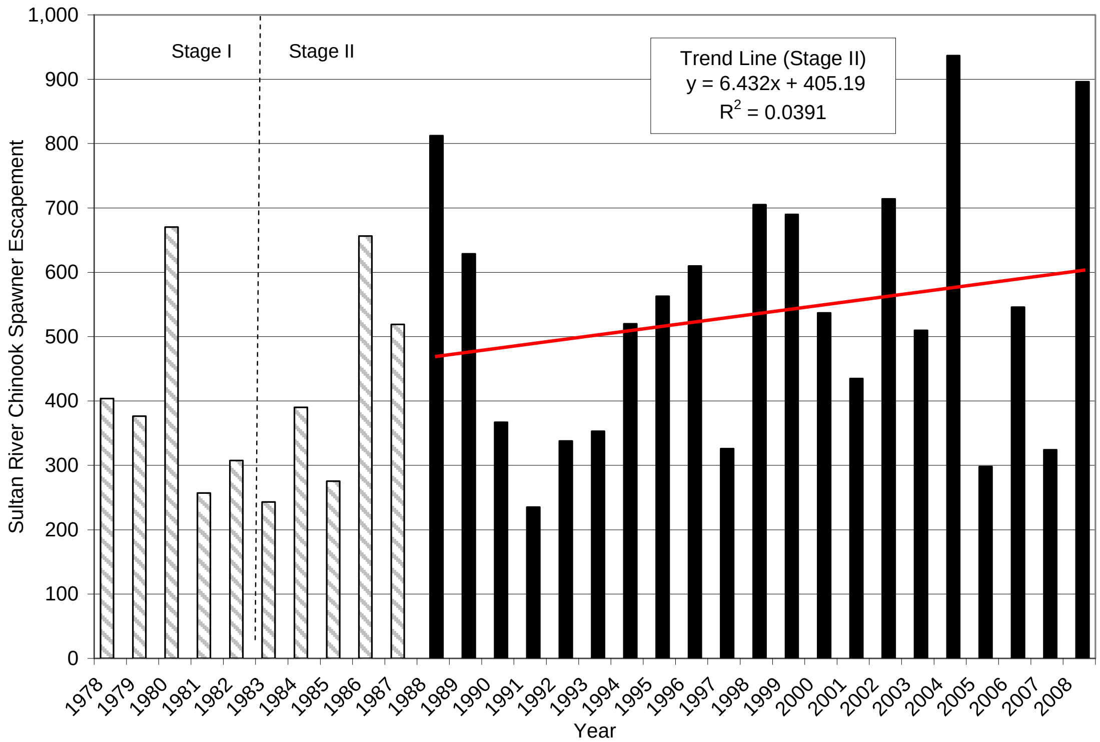
Information describing the spatial and temporal distribution of Chinook salmon in the Sultan River was collected in the mainstem Sultan River in 2007 and 2008 as part of the Sultan River Juvenile Fish Occurrence, Life History and Distribution study (R2 Resource Consultants 2009). In total, over 134,000 juvenile salmonids were observed on the lower Sultan River, only two of which were from juvenile Chinook salmon during the fall survey periods. This strongly suggests a stream-type (over-wintering) life history is absent or uncommon in the Sultan River or that the majority of juvenile Chinook freshwater over-wintering behavior takes place downstream in the Skykomish or Snohomish rivers.



Source: R2 Resource Consultants (2008c). Note: Green bars (or light grey) show when the life phase occurs; blue (or black) bars are the known peak timing.

Figure E.6.3-6 Life stage periodicities of anadromous and resident salmonids present within the Sultan River basin.

The existing flow regime in the Sultan River downstream of the Division Dam was implemented in June of 1984 (Stage II of the Project). Chinook spawning in that year were the first brood year influenced by Stage II flows. The adult progeny of spawners from this brood began to return to the Sultan River in 1988. From 1988 to 2008, the Chinook spawner escapement to the Sultan River averaged 540 fish annually (Figure E.6.3-7), or approximately 9 percent of the total escapement to the Snohomish River basin[18], even though the Sultan River contains only about 6 percent known Chinook spawning habitat in the Snohomish River basin. From 1978[19] to 1987 (prior to Stage II operations), the Chinook spawner escapement to the Sultan River averaged 410 fish annually (Figure E.6.3-7).



Note: Hatched bars depict escapement during Stage I; solid bars show Stage II.

Figure E.6.3-7 Total Sultan River Chinook spawner escapement 1978-2008.

Although average annual Chinook escapement to the Sultan River has been slightly higher under Stage II operations, the difference observed between Stage I and Stage II (from 410 to 540 fish) is not statistically significant at $p<0.05$ (P-value = 0.0691, two-tailed T-test assuming unequal variance) due to the high annual variability observed under both stages and the small sample size associated with Stage I monitoring. One should also be cautious in comparing Stage I and Stage II escapements because environmental factors such as water year type, harvest rates, hatchery fish influence, and marine productivity/survival can greatly affect Chinook abundance within and outside the

[18] Based on data from 1988 through 2007.
[19] Data collection started in 1978.

Sultan River basin. These factors are not under the control of the Project and probably varied dramatically between the two time periods.

The Sultan River Chinook escapement data also suggests a slightly increasing trend under Stage II conditions over time (Figure E.6.3-7), although the correlation coefficient (R = 0.197) indicates substantial annual variation. In addition, the trend analysis shown in Figure E.6.3-7 is confounded by stray hatchery fall Chinook derived from programs elsewhere in the Snohomish River basin. In the late 1990s, the District cooperated with WDFW and the Tulalip Tribes to study stray rates of hatchery-origin fall Chinook salmon in the Snohomish River. Results showed that from 1990 through 2001, about 41 percent of spawning Chinook in the Snohomish basin were of hatchery origin (PSMFC 2002; Puget Sound TRT 2001). Since production of fall Chinook at the Wallace River Hatchery was curtailed in 1998, the natural-origin Chinook trend has increased at a greater rate with less annual variability (Figure E.6.3-8) than suggested by total Sultan River Chinook escapement trends presented in Figure E.6.3-7 (which includes hatchery fish).

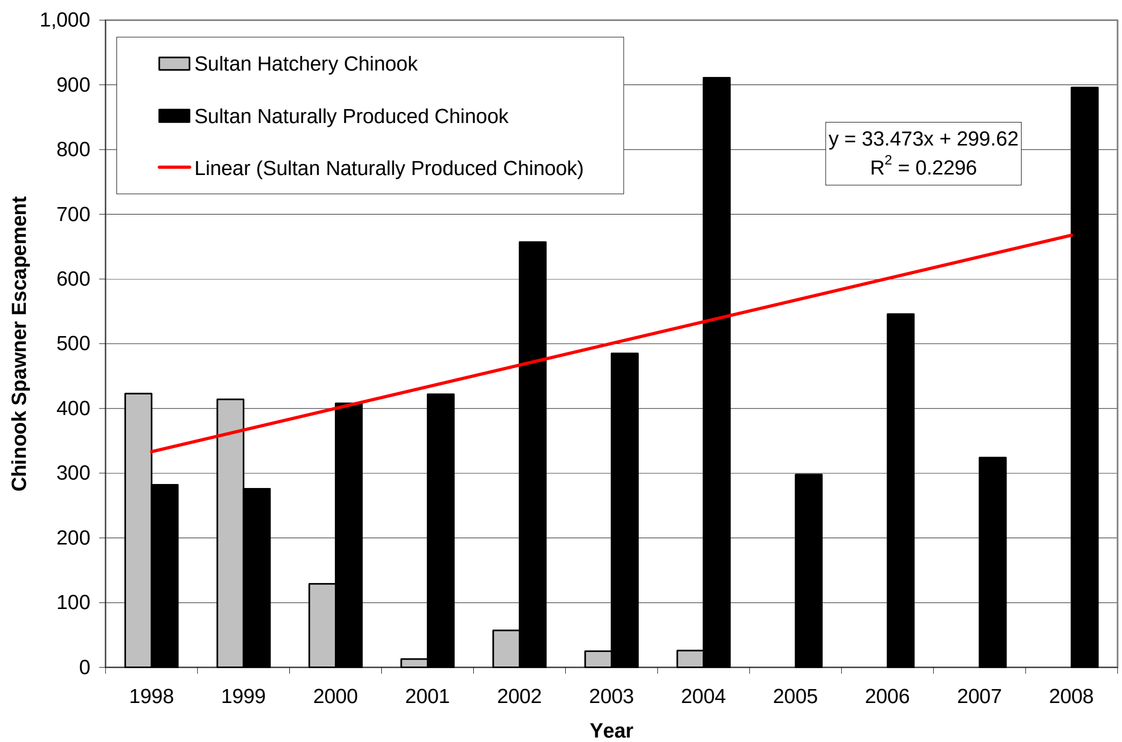


Figure E.6.3-8 Natural-origin Chinook spawner escapement 1998-2008.

During PM&E discussions, the stakeholders requested a trend analysis to compare Sultan River salmon and steelhead escapements with other populations from the Snohomish River basin. As stated above, a comparison of natural-origin escapement is most appropriate for Sultan River Chinook due to the confounding effect of hatchery Chinook escapement in the rest of the Snohomish basin. While the District has data on natural-origin Chinook escapement for the Sultan River (Figure E.6.3-8), such data are not available for the Snohomish basin as a whole. The District requested Snohomish basin natural-origin Chinook spawner escapement data from WDFW, but this data has not been provided to date.

Federal and State Status

Chinook salmon in the Puget Sound Chinook Salmon ESU were listed as threatened under the ESA on March 24, 1999 (Table E.6.3-2). The naturally spawning population of Chinook salmon found in the Sultan River below the Diversion Dam is included in this ESU. The Sultan River from its confluence to the Diversion Dam is also designated EFH for Chinook salmon under the Magnuson-Stevens Act.

Table E.6.3-2 The Federal Endangered Species Act status and WDFW Stock Status for salmonids present in the Sultan River basin.

ESU/DPS	Federal ESA Status	WDFW Stock Status
Puget Sound Chinook Salmon ESU (Skykomish Chinook)	Listed as a threatened on March 24, 1999; threatened status reaffirmed on June 28, 2005.	Depressed
Puget Sound/Strait of Georgia Coho Salmon ESU (Skykomish coho)	Listing not warranted on July 25, 1995, but classified as a Species of Concern on April 15, 2004 due to specific risk factors.	Healthy
Odd-year Pink Salmon ESU (Snohomish Odd-year Pink)	Not Warranted	Healthy
Even-year Pink Salmon ESU Snohomish Even-year Pink	Not Warranted	Healthy
Puget Sound/Strait of Georgia Chum Salmon ESU (Skykomish Fall Chum)	Not Warranted	Healthy
Puget Sound Steelhead DPS (Snohomish/Skykomish Winter Steelhead)	Listed as threatened on May 7 and published on May 11, 2007.	Depressed
Coastal-Puget Sound Bull Trout/Dolly Varden Char DPS	Listed as threatened on November 1, 1999.	Healthy
Puget Sound Coastal Cutthroat Trout ESU	Not Warranted	Unknown

ESU = Evolutionarily Significant Unit
DPS = Distinct Population Segment

In 2002, the Skykomish Chinook stock status was considered "depressed" by WDFW due primarily to low stock productivity (WDFW 2002a). The two Snohomish River basin Chinook stocks (Skykomish and Snoqualmie), both of which are considered native, are managed as a single unit, with a minimum escapement goal for natural spawners of 5,250 per year. This goal, established in 1978, was achieved in 7 of the last 10 years (1998-2007), though escapements have been far short of the ESA recovery goal determined by NMFS.

E.6.3.1.2.2 Coho Salmon

General Life History and Habitat Requirements

In Washington, Oregon, and California, coho salmon typically migrate to saltwater in the spring of their second year, spend 16 to 20 months rearing in the ocean, and then return to freshwater as three-year-old adults. In addition, a variable proportion (6 to 43 percent) of males ("jacks") return to freshwater to spawn after only 5 to 7 months in the ocean (Weitkamp et al. 1995).

Coho typically spawn between September and late-January. In general, they migrate further upriver than pink and chum salmon (described below) but usually not as far as Chinook (Sandercock 1991), and tend to use smaller tributaries for spawning than Chinook. Preferred spawning sites are usually located in the gravelly transition areas between pools and riffles and are often associated with cover that provides protection from predation.

Following deposition in the gravel, coho salmon eggs normally incubate for 35 to 50 days (Shapovalov and Taft 1954). As with other Pacific salmonids, successful incubation depends to a large extent on the stream and streambed conditions. Winter flooding with substantial bedload movement, low flows, heavy silt loads, infections, and predation can each substantially reduce egg survival.

Following emergence from the gravel, coho fry form schools and move into shallow, low velocity areas typically found in backwater pools, dam pools, and beaver ponds (Reeves et al. 1989). Like Chinook, coho fry are often associated with cover such as overhanging or submerged logs, undercut banks, overhanging vegetation, or large substrate. These structures afford protection from predation and increased macroinvertebrate production for food. As coho fry become older, they begin to occupy areas near the open shoreline and progressively move into areas of higher velocity (Sandercock 1991, Reeves et al. 1989). However, during the winter, juvenile coho move back into side channels and backwater channels, especially those areas with heavy groundwater influence. These areas provide protection from extreme flows, freezing temperatures, and predation.

Local Stock Information

According to WDFW (2002a), four coho salmon stocks spawn and rear in the Snohomish River basin: Snohomish coho, Skykomish coho, South Fork Skykomish coho, and Snoqualmie coho. Because there are no genetic data and no significant timing differences or unique biological characteristics among these stocks, their distinction is based primarily on geographic spawning separation (Haring 2002).

The Sultan River downstream of the diversion dam provides habitat for a limited number of Skykomish stock coho salmon. Skykomish stock coho spawn in the mainstem and tributaries of the Skykomish River (excluding the South Fork Skykomish upstream of Sunset Falls) and North Fork Skykomish River. Most spawning occurs from early November through January and emergence occurs from mid-March through early June

(Figure E.6.3-6). The out-migration of coho smolts in the Sultan River occurs between April and early June (CH2M Hill 2005).

While coho salmon spawning has been documented in the Sultan River upstream to RM 9.7, the steep gradient and incised channel in the canyon reach limits the amount of available spawning habitat. Furthermore, all but two tributaries below Culmback Dam have natural waterfall barriers to upstream migration at their mouths (coho are generally small- to medium-sized tributary spawners). Results of the Sultan River Juvenile Fish Occurrence, Life History and Distribution study from 2007 and 2008 indicate that in July and September in particular, all three side-channels surveyed in OR-1 had relatively high mean abundances of coho (Figure E.6.3-9) (R2 Resource Consultants 2009). In general, juvenile coho were much less abundant in mainstem habitat.

(Source: R2 Resource Consultants 2009).

Figure E.6.3-9 Juvenile coho observed at a mainstem index site in the Sultan River.

During the late fall/early winter when coho salmon spawn, high flows and frequent turbidity inhibit accurate counts of adults and redds in the Sultan River. As a result, historical coho salmon spawning survey data are limited; however, annual escapement to the Sultan River is believed to be 300 to 500 adults, representing a small fraction of the Snohomish River basin escapement. Coho spawning habitat in the Sultan River comprises about 3.5 percent of that available in the Snohomish basin.

Federal and State Status

On October 27, 1993, NMFS published a notice stating that a listing may be warranted for certain populations of coho salmon in Washington, Oregon, and California. On July 25, 1995 NMFS issued a proposed rule stating, among other findings, that the Puget Sound/Strait of Georgia ESU was being added to the candidate species list (Table E.6.3-2). At the time of the notice, NMFS found that there was not adequate information available to indicate that coho salmon in the ESU warranted protection under the ESA. While not listed under the ESA, the Sultan River from its confluence to the Diversion Dam is considered EFH for coho salmon.

According to WDFW (2002a), the Skykomish coho stock is likely a mixture of native and introduced non-native stocks, and the status of the stock is designated as “healthy”, based on increasing spawning escapement trends. The Snohomish River basin escapement goal of 70,000 spawners was met in 7 of 10 years from 1995 to 2004, and escapement numbers reached a record high of 261,848 in 2001 since data collection began 1965.

E.6.3.1.2.3 Pink Salmon

General Life History and Habitat Requirements

Pink salmon are distinguished from other Pacific salmon by having a fixed 2-year life cycle and relatively small size (weighing an average of 4 pounds at maturity) (Wydoski and Whitney 2003). Like chum salmon (described below), they use freshwater almost exclusively as a spawning and incubation environment, moving downstream to the ocean or estuary almost immediately after emergence. In Washington and southern British Columbia, river entry usually occurs from July to October, and spawning is observed from August to October (Heard 1991).

Pink salmon spawn in relatively fast-flowing shallow water in small, clear water drainages (Hard et al. 1996). They often spawn in the lower reaches of rivers and streams, and many are known to spawn in the intertidal areas. Most pink salmon spawning occurs in riffles, with water ranging from 0.9 to 3.3 feet deep; however, in dry years, redds can be found at shallower depths (Heard 1991). Pink salmon generally avoid spawning in deep, slow-moving water or on muddy, sandy, or heavily silted substrate (Heard 1991).

The rate of pink salmon egg development in the redd depends on water temperature; however, pink salmon eggs usually hatch in early to mid-winter. Following emergence from the gravel, pink salmon fry migrate immediately downstream into salt water. The out-migration is short, peaking in late winter and early spring, and is usually complete by May (Heard 1991). The emergence and out-migration of fry is heaviest at night and usually lasts for several weeks. After a few weeks to a few months in estuaries and nearshore habitat, pink salmon move offshore and remain at sea for 12 to 16 months (Heard 1991).

Local Stock Information

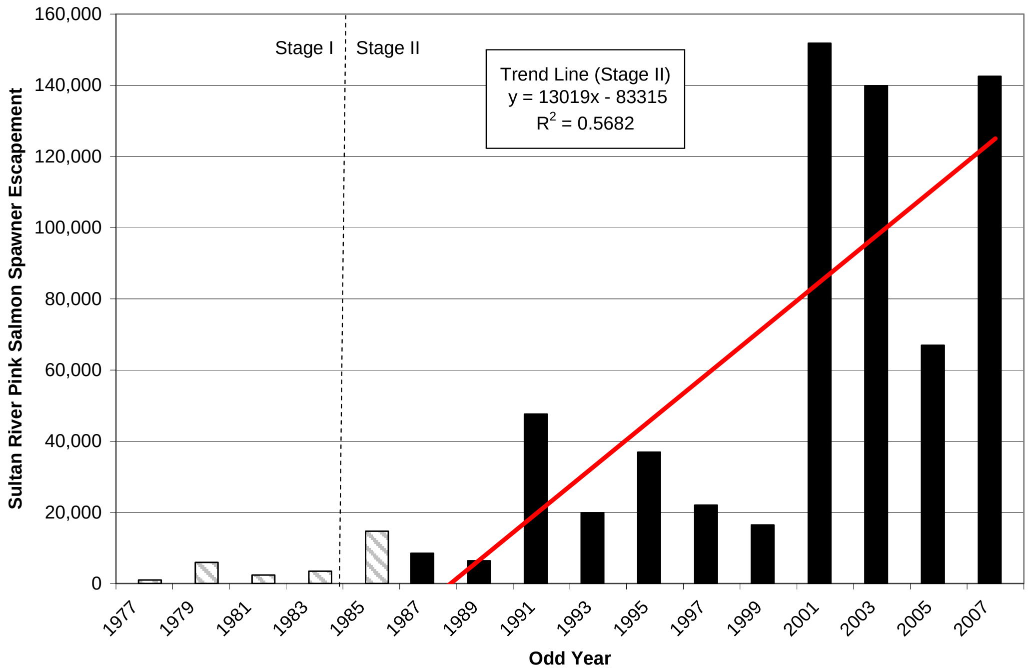
There are 14 recognized pink salmon stocks in the Puget Sound region (WDFW 2002a). All of these spawn in odd years except for the two stocks in the Snohomish River basin that spawn in both odd and even years. The Snohomish odd-year stock spawns from September through October (Figure E.6.3-6). The Snohomish even-year stock spawns primarily in September. Only the odd-year run has been observed spawning in the Sultan River, primarily downstream of RM 3.0 (CH2M Hill 2005).

As described in the previous section, juvenile pink salmon fry spend less time in freshwater than most other salmon species, out-migrating to saltwater as fry. As such, juvenile residency in the Sultan River is minimal. Results of the Sultan River Juvenile Fish Occurrence, Life History and Distribution study from 2007 and 2008 indicate very few pink salmon fry were present during the survey months (April-July and September); all observations of pink salmon occurred in April and May (R2 Resource Consultants 2009). Congregations of both pink and chum were observed behind woody debris accumulations and generally not associated with other species. Chum and pink fry were not present in the Sultan River during summer snorkel surveys.

There are no hatchery programs for pink salmon in the Puget Sound region; consequently, all pink salmon returning to the Snohomish River basin are considered natural-origin fish. Under Stage I operations (1971 to 1985), pink salmon escapement to the Sultan River averaged 4,950 fish per 2-year cycle (Figure E.6.3-10), or about 2.8 percent of the escapement to the entire Snohomish River basin. Under Stage II operations, escapement to the Sultan River averaged 59,889 fish per 2-year cycle, or about 17 percent of the Snohomish River basin escapement per year, even though the Sultan River contains only about 8.4 percent of the pink salmon spawning habitat in the Snohomish River basin.

While pink salmon escapement to the Sultan River has increased dramatically under Stage II operations, trend analysis indicates the rate of increase in the Sultan River is less than what has been observed in the Snohomish River basin as a whole (Figure E.6.3-11). Further increases in escapement to the Sultan River are probably unlikely, as the amount of available spawning habitat area in the lower Sultan River has likely reached its carrying capacity. For example, in 2003, approximately 1.4 million pink salmon spawned in the 89.5 miles of identified spawning habitat in the Snohomish River basin. This equates to an average density of 15,642 pink salmon per mile of available spawning habitat. During the same year, 139,800 pink salmon spawned in 2.7 miles of the Sultan River for an average density of 51,778 fish per mile, or 3.3 times the density observed throughout the entire Snohomish River basin.

Pink salmon escapement to the Sultan River under Stage II operation has a high positive correlation with escapement to the remainder of the Snohomish River (correlation coefficient [R] = 0.93, 1987-2005). In other words, trends in yearly variation between the Sultan River and Snohomish basin pink salmon escapement closely follow each other.



Note: Hatched bars depict escapement during Stage I; solid bars show Stage II.

Figure E.6.3-10 Sultan River pink salmon spawning escapement 1977-2007.

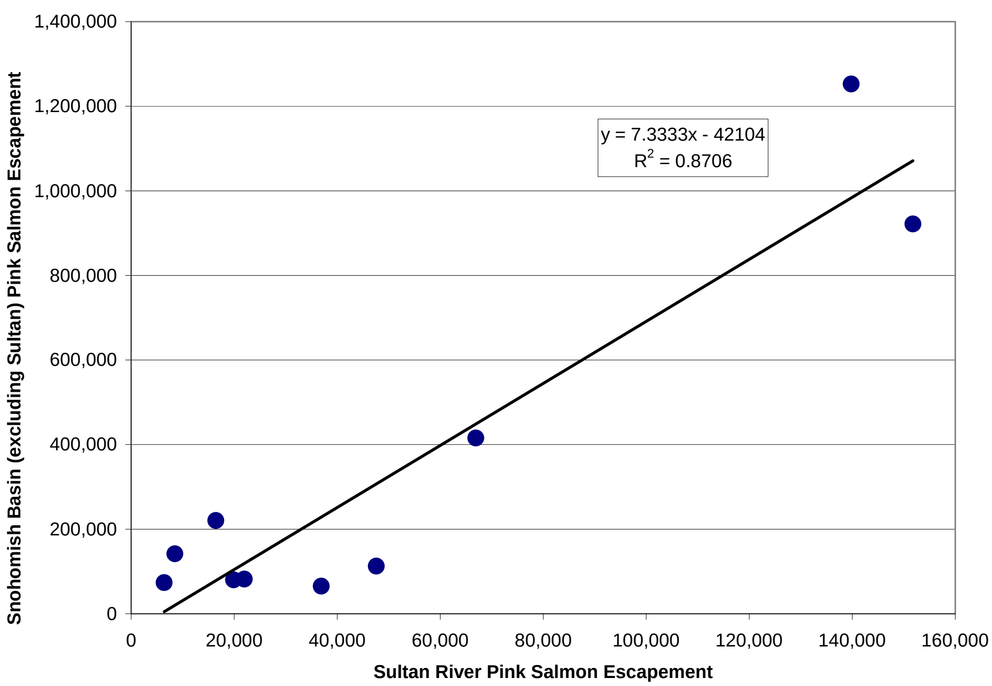


Figure E.6.3-11 Sultan River vs. Snohomish River basin (excluding Sultan River) pink salmon escapement correlation under Stage II conditions (1991-2005); no Snohomish basin data are available for 2007.

Federal and State Status

In 1995, NMFS conducted a review of pink salmon ESUs and concluded that neither the Puget Sound even-year ESU nor the Puget Sound odd-year ESU warranted listing under the ESA (Table E.6.3-2). While not listed under the ESA, the Sultan River from its confluence to the Diversion Dam is considered EFH for Puget Sound pink salmon.

According to WDFW, the Snohomish odd-year pink salmon stock is "healthy". The escapements of the odd-year stock have substantially increased through the years since enumeration began in 1984 (WDFW 2002a). The Snohomish even-year pink salmon stock is also considered "healthy". The escapements of this stock have been very stable, showing a slight increasing trend over the last 40 years. Both pink salmon stocks are considered native.

E.6.3.1.2.4 Chum Salmon

Chum salmon enter freshwater at an advanced stage of sexual development and typically spawn in the lower reaches of rivers, with redds usually dug in the mainstem or in side channels just above tidal influence. The species rarely penetrates rivers more than 100 miles (Scott and Crossman 1973). Like pink salmon, juvenile chum salmon emerge from the gravel in the spring and outmigrate to saltwater almost immediately following emergence (Salo 1991). However, in Washington, they may reside in freshwater for as long as a month, migrating from late January through May (Johnson et al. 1997). This ocean-type life history strategy reduces the mortality associated with the variable freshwater environment, but makes chum more dependent on estuarine and marine habitats.

Throughout their range, chum salmon mature between 3 and 5 years of age and enter their natal river systems from June to March (Salo 1991). In Washington, a variety of seasonal runs are recognized, including summer, fall, and winter populations. Fall-run fish predominate, but summer runs are found in Hood Canal, the Strait of Juan de Fuca, and in southern Puget Sound (WDFW 2002a).

Generally, chum salmon prefer to spawn in relatively shallow, low gradient, low velocity streams and side channels. Sub-gravel flow (upwelling groundwater) may also be important in the choice of redd sites (Salo 1991); however, WDFW reported that chum salmon in Washington do not preferentially choose areas of upwelling groundwater and most commonly spawn at the head of riffles (Johnson et al. 1997).

As with all salmonids, the rate of egg incubation and emergence depends to a large degree on water temperatures. Typically, incubating chum salmon eggs hatch in about 2 to 18 weeks (Wydoski and Whitney 2003, Johnson et al. 1997). Most chum salmon fry emerge from the gravel during the nighttime hours and promptly migrate downstream to estuarine water where they remain until they make the transition to areas of higher salinity (Wydoski and Whitney 2003, Johnson et al. 1997).

Local Stock Information

WDFW (2002a) recognizes 69 chum salmon stocks in Puget Sound region. Three of these, Skykomish, Snoqualmie, and Wallace fall chum spawn in the Snohomish River and its tributaries. The chum salmon found in the Sultan River are the Skykomish fall chum stock. In the Sultan River, fall chum spawning activity is concentrated in the mainstem and side channels downstream of RM 2.7. A particularly heavy concentration of spawning activity has been documented in a right bank side channel near Kien's Bar (RM 1.5) when adequate flow conditions exist. Chum salmon migration up the Snohomish River begins in September and continues through December. Spawning takes place in November and December (Figure E.6.3-6). Juvenile out-migration occurs from February through May.

Results of the Sultan River Juvenile Fish Occurrence, Life History and Distribution study from 2007 and 2008 found very few chum fry during the survey months (April through July and September). All chum salmon were observations were in April and May (R2 Resource Consultants 2009). Similar to pink salmon, the short residence time after emergence probably explains the lack of chum fry observed during the summer.

Information from historical spawning surveys indicates that very few chum salmon spawned in the Sultan River prior to operation of the Project. Chum salmon escapement in the Sultan River has been tracked regularly only since 1991. From 1991 to 2005 (available data range), escapement averaged approximately 2,675 fish annually, with the greatest yearly abundance (7,573 fish) observed in 2002 (Figure E.6.3-12).

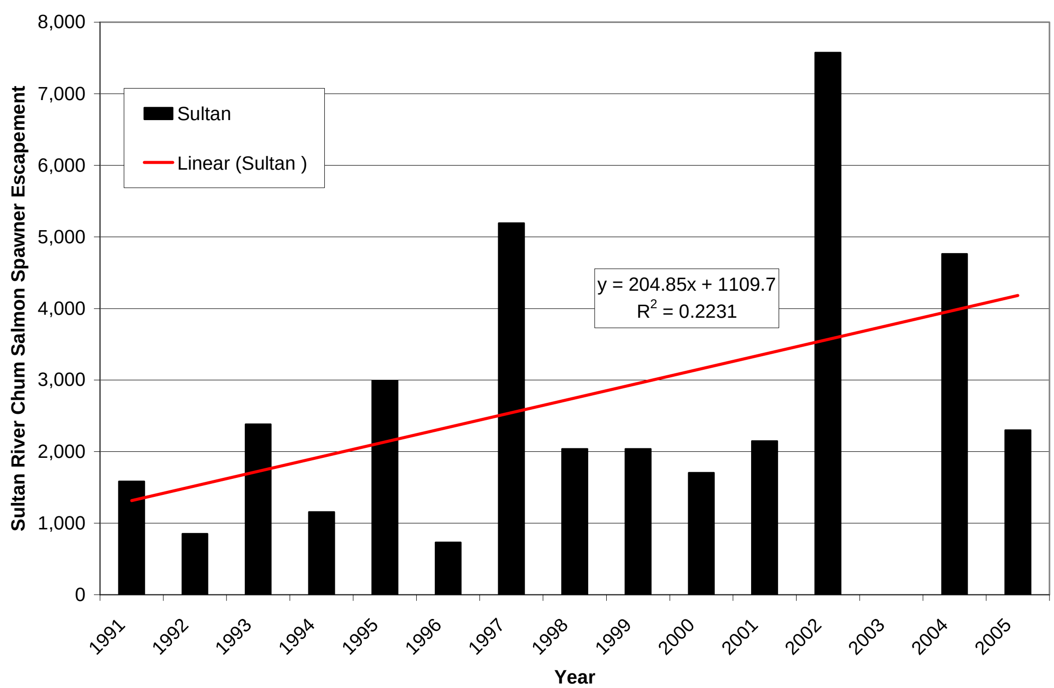


Figure E.6.3-12 Sultan River chum salmon escapement trend under Stage II conditions (1991-2005); no Sultan River data available for 2003.

From 1991 to 2005, escapement to the Sultan River averaged about 11 percent of the total chum salmon escapement to the Snohomish River basin, even though their primary spawning area in the Sultan River is only 4.2 percent of the known chum salmon spawning habitat in the Snohomish River basin (WDFW 2002b). In 1997, chum escapement to the Sultan was higher than in the rest of the Snohomish basin combined (Sultan River = 5,192 fish, the remainder of Snohomish basin = 3,128 fish).

From 1991 to 2005, chum escapement to the Sultan River and Snohomish River basin had a low degree of correlation (correlation coefficient [R] = 0.47) (Figure E.6.3-13), (i.e., trends in yearly variation between the Sultan River and Snohomish basin chum salmon escapement did not closely follow each other). There is considerable variability in Snohomish basin chum escapement, some of which is due to high juvenile competition in estuarine habitats with overwhelming numbers of pink salmon in odd years. Overall chum escapement variability is lower (i.e., more stable) in the Sultan River than the Snohomish basin as a whole.

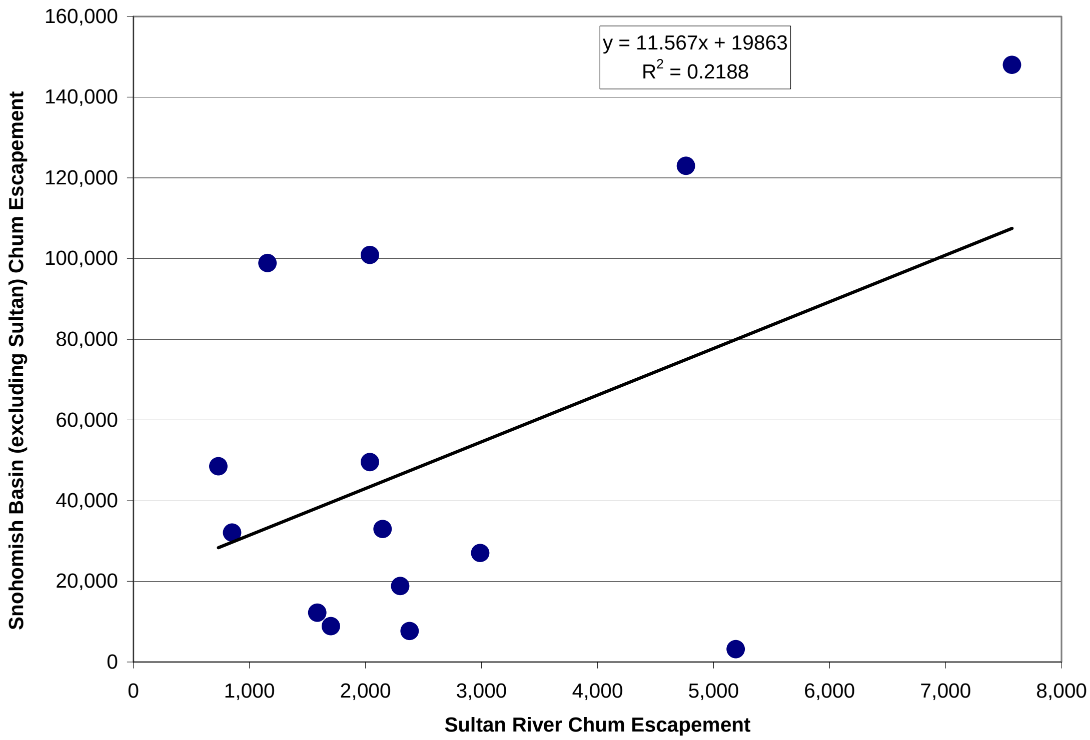


Figure E.6.3-13 Sultan River vs. Snohomish basin (excluding Sultan River) chum salmon correlation under Stage II conditions (1991-2005).

Federal and State Status

Sultan River chum salmon are part of the Puget Sound/Strait of Georgia chum ESU. In 1998, NMFS determined that ESA listing was not warranted for this ESU (Table E.6.3-2). According to WDFW (2002a), the Skykomish fall chum stock status is “healthy”, based on trends in spawning escapement levels. Skykomish fall chum is considered a native stock.

E.6.3.1.2.5 Steelhead

O. mykiss exhibit a remarkable range of life histories. The species can be either anadromous (steelhead) or freshwater resident (rainbow trout), and where the two forms co-occur, the progeny of resident rainbow trout have the potential to become anadromous and the progeny of steelhead have the potential to become resident (Peven 1990). Unlike other species of *Oncorhynchus*, except *O. clarki* (described in the following section), steelhead are capable of spawning more than once before they die (Busby et al. 1996). However, the majority of steelhead spawn only once in their life.

In Washington, steelhead typically migrate to the marine environment at age 2 to 3, but are known to spend up to 7 years rearing in freshwater. Peak outmigration occurs in the late spring and early summer. They then reside in the ocean for 2 or 3 years prior to returning to their natal stream to spawn. Steelhead adults usually spawn from December through June (Bell 1990; Busby et al. 1996). Incubation rates vary with water temperature, with fry emergence typically occurring 40 to 80 days after spawning (Barnhardt 1991).

Throughout their range, steelhead populations are regularly classified into two distinct behavioral forms based on the timing of their spawning migration. Summer steelhead enter fresh water in a sexually immature condition and require from several months to a year to mature and spawn. Winter steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. The majority of the steelhead in Puget Sound region are winter steelhead, but summer steelhead are also present in some of the larger river systems (Busby et al. 1996). The population in the Sultan River basin is a winter-run and typically spawns from March through June (Figure E.6.3-6).

The most common steelhead redd site is at the tail of a pool close to the point where the smooth surface water breaks into the riffle below. Like other Pacific salmon, these areas are often associated with deep pools and abundant instream cover. Unlike Chinook and coho, most steelhead in their first year of life live in riffles, but some larger fish also inhabit pools or deep fast runs (Barnhart 1991). Instream cover such as large rocks, logs, root wads, and aquatic vegetation are very important for juvenile steelhead. This cover provides resting areas, visual isolation from competing salmonids, food, and protection from predators. Often steelhead densities are highest in streams with abundant instream cover.

Local Stock Information

WDFW (2002a) recognizes 60 stocks of steelhead in the Puget Sound region. Six of these are found in the Snohomish River basin; three summer steelhead stocks (North Fork Skykomish, South Fork Skykomish, and Tolt summer steelhead) and three winter steelhead stocks (Snohomish-Skykomish, Pilchuck, and Snoqualmie winter steelhead). The naturally spawning steelhead in the Sultan River basin are the Snohomish-Skykomish winter stock.

Steelhead spawn and rear in the mainstem Sultan River below the City of Everett's Diversion Dam at RM 9.7 (CH2M Hill 2005). Wild (non-hatchery) steelhead spawn primarily in April and May (Figure E.6.3-6). Fry begin to emerge from the gravel in early June and continue to emerge through July. The few tributaries in this reach are small and short, thus containing very limited steelhead rearing habitat. Hatchery steelhead usually return to the basin from June through January, and spawn prior to March 15th, primarily in the lower 3.0 miles of the Sultan River (WDG 1980). The Washington Department of Game (WDG, now WDFW) (1980) hypothesized that most spawners above RM 3.0 are wild fish.

Juvenile surveys in the Sultan River (WDG 1986) showed rapid steelhead fry growth. Mean length doubled from June to November and weights (estimated from published length/weight relationships) increased nearly tenfold. Steelhead smolts out-migrate from the Sultan River from April through May (CH2M Hill 2005). Results of the Sultan River Juvenile Fish Occurrence, Life History and Distribution study from 2007 and 2008 indicate the highest densities of juvenile "trout" occurred in July and September in mainstem and side-channel sites (R2 Resource Consultants 2009).

Under the existing license, the District supports hatchery winter steelhead programs in the Snohomish River system by compensating WDFW for planting roughly 30,000 smolts annually to mitigate for the lack of fish passage at the Diversion Dam. This measure is part of a larger stocking effort in the Snohomish River system that includes the Pilchuck, Wallace, and the North Fork Skykomish rivers. Hatchery broodstock is collected at Tokul Creek Hatchery in the Snohomish drainage (winter steelhead) and Reiter Ponds in the Skykomish drainage (summer steelhead). Once broodstock numbers are reached, surplus hatchery-origin adults are left in the river for sport harvest (HSRG 2004). Eggs from Tokul Creek Fish Hatchery and Reiter Ponds are moved to Wallace Fish Hatchery for incubation and rearing. All smolts are adipose fin-clipped before being released. In 2006 (the most recent data available), 15,660 winter steelhead and 20,330 summer steelhead were released into the Sultan River (Steelhead Harvest Summary - http://wfdw.wa.gov/fish/harvest/06-07/smolts.htm) (Table E.6.3-3).

Table E.6.3-3 Annual steelhead smolt releases in the Sultan River.

	Steelhead Releases		
Year	Winter	Summer	Total
1996-1997	17,200	9,700	26,900
1997-1998	7,700	15,100	22,800
1998-1999	43,600	15,400	59,000
1999-2000	45,000	13,300	58,300
2000-2001	No Data	No Data	No Data
2001-2002	17,700	20,600	38,300
2002-2003	29,100	14,900	44,000
2003-2004	24,600	10,450	35,050
2004-2005	19,906	20,447	40,353
2005-2006	20,270	20,340	40,610
2006-2007	15,660	20,330	35,990
2007-2008	15,100	28,400	43,500
Average	23,258	17,179	38,650

The District and WDFW conduct annual wild winter run steelhead spawning surveys in index reaches between RM 0.0 and RM 9.7. Between 1993 and winter of 2007/2008, annual escapement estimates have ranged from 66 to 574 adult spawners (Figure E.6.3-14). Although the period of record is short, the Sultan River winter steelhead escapement averages about 4 percent of the total Snohomish basin escapement (range 2 to 9 percent), while the Sultan provides about 5.4 percent of the available steelhead spawning habitat in the Snohomish basin.

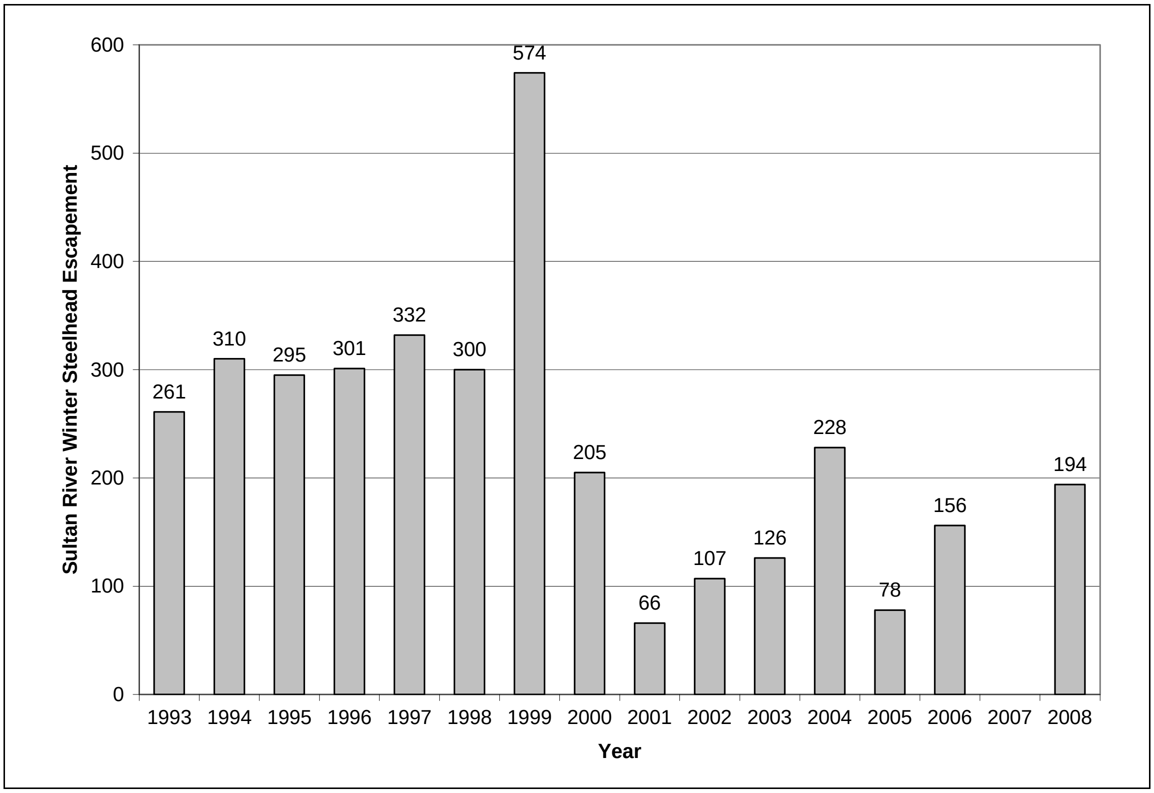


Figure E.6.3-14 Sultan River steelhead spawning escapement 1993-2008 (no data for 2007).

Available data suggest that both Sultan River and Snohomish basin steelhead escapement have declined since regular surveys began in 1993 (Figure E.6.3-14 and E.6.3-15), and the escapement goal of 6,500 spawners for the entire Snohomish basin has not been achieved since 1995. From 1989 to 2006 (with 12 years of data), Sultan River and Snohomish basin steelhead escapement estimates have only a moderate degree of correlation (correlation coefficient [R] = 0.50) (Figure E.6.3-15) (i.e. trends in yearly variation between the Sultan River and Snohomish basin steelhead escapement do not closely follow each other.

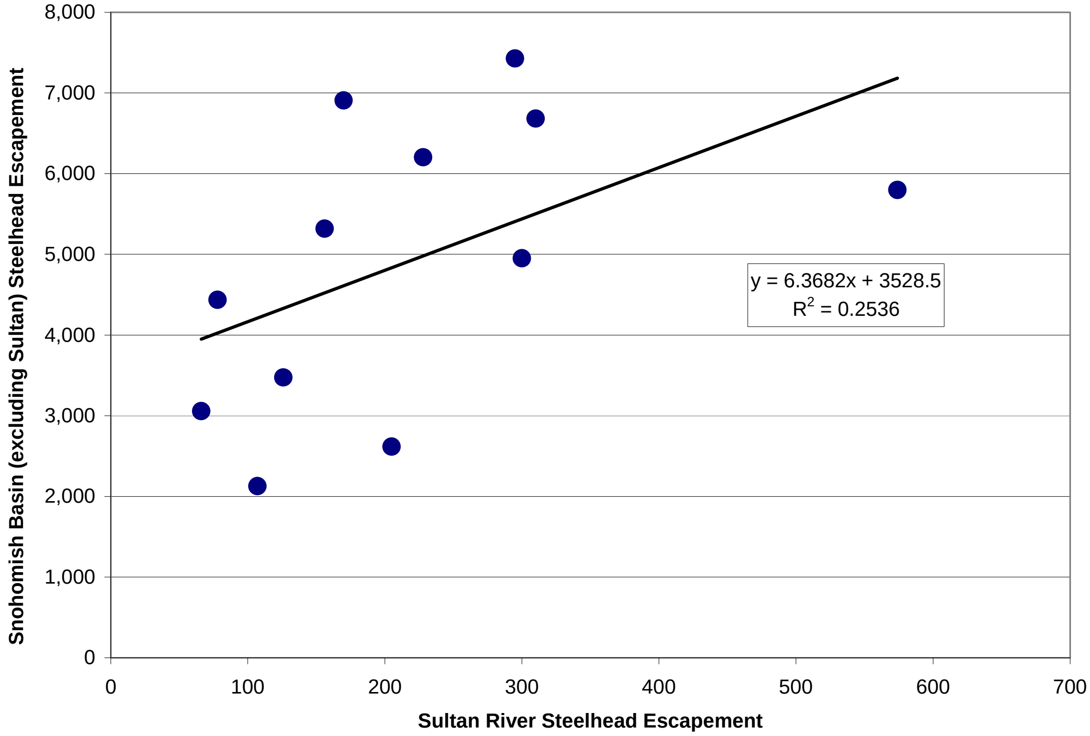


Figure E.6.3-15 Sultan River vs. Snohomish basin (excluding Sultan River) steelhead correlation under Stage II conditions (1989-2006); no data for some years.

In 2007, the District conducted a cutthroat trout population survey the Sultan River bypass reach (OR-3) (Normandeau and TRPA 2008). Subsequent genetic analysis confirmed that all sampled trout were rainbow trout (no cutthroat trout were observed during sampling). Based on these study results, there appears to be a self-sustaining and naturally reproducing population of rainbow trout in the bypass reach. Studies have shown that resident rainbow can produce anadromous off-spring (Shapovalov and Taft, 1954; Burgner et al. 1992), which could contribute to steelhead recruitment downstream of the Diversion Dam. However, Mullan et al. (1992) found evidence that in very cold streams, juvenile steelhead had "difficulty attaining mean threshold size for smoltification" and concluded that "most fish in their sampling area [Methow River, Washington] that did not emigrate downstream early in life were thermally fated to a resident life history regardless of whether they were the progeny of anadromous or resident parents" (Mullan et al. 1992).

Federal and State Status

Puget Sound steelhead were listed as threatened under the ESA on May 11, 2007 (72 FR 26722) (Table E.6.3-2). The naturally spawning steelhead in the Sultan River are included in the Puget Sound Distinct Population Segment (DPS). WDFW considers the Snohomish/Skykomish winter steelhead stock to be “depressed” due to the severe short-term decline in total escapements since 1999 (WDFW 2002a). According to WDFW (2002a), Snohomish/Skykomish winter steelhead is a native stock with wild production.

E.6.3.1.2.6 Bull Trout

Bull trout are members of the char subgroup of the family Salmonidae and are native to waters of western North America. In Washington, they are found in the Columbia River system, in coastal rivers from Grays Harbor north, and in rivers of Puget Sound. Like *O. mykiss*, bull trout exhibit both resident and migratory life-histories and have the ability to spawn more than once before they die. Resident bull trout complete their entire life cycle in tributary streams. Migratory bull trout spawn in tributary streams where juveniles rear for up to 6 years before migrating to either a lake (adfluvial), river (fluvial), or in certain coastal areas, migrate seasonally to saltwater (amphidromous) (Fraley and Shepard 1989; Goetz 1989). Adfluvial, fluvial, and amphidromous bull trout populations are present in the Puget Sound region.

Bull trout habitat utilization is strongly influenced by water temperature and researchers recognize temperature as the most consistent factor influencing bull trout distribution (USFWS 1998). Optimum water temperatures for bull trout range from 2 to 10°C (36 to 50°F), while temperatures above 15°C (59°F) are thought to provide a thermal barrier for most bull trout (63 FR 31693). Successful spawning requires water temperatures below 8°C (46.4°F) during the late summer and fall (WDFW 1999). Successful egg incubation requires temperatures below 4.4°C (39.9°F). As a result, redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater inflow (64 FR 58910).

In the summer, juvenile bull trout typically occupy habitats with water temperatures ranging from 9 to 15°C (48 to 59°F), channel gradients of 10 to 20 percent, moderate to fast currents, and stream widths of 2 to 5 meters (6.5 to 16.4 ft) (Goetz 1989). Resident adults often overwinter in deep pools or migrate downstream to deeper water near tributary mouths. Fluvial adults winter in deep pools, or in lower reaches of mainstream rivers, to make use of woody debris and overhanging banks for cover (Goetz 1989). Watson and Hillman (1997) found direct relationship between bull trout density, maximum pool depth, and percentage of undercut banks.

Mature bull trout typically spawn from August to November during periods of decreasing water temperatures. Preferred spawning habitat consists of low gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989; Pratt 1992; Rieman and McIntyre 1993). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992). Fry normally emerge from the gravel in early April through May (Pratt 1992).

<u>Local Stock Information</u>

There are four bull trout populations in the Snohomish basin: North Fork Skykomish, South Fork Skykomish, Salmon Creek, and Troublesome Creek (Shared Strategy Committee 2007). Three of these populations migrate to the estuary and nearshore for the spring and summer, and immature fish use the lower reaches of the Snohomish River from Ebey Slough to Thomas' Eddy during the winter months. Mature adult fish migrate all the way upriver to spawn primarily in the Upper North Fork Skykomish River and its tributaries, as well as in the Foss River above Sunset Falls.

While all life stages of bull trout have been documented in Snohomish River basin, they have only been observed sporadically in the Sultan River, and always downstream of RM 9.7 (CH2M Hill 2005). Bull trout have not been observed in the upper Sultan River basin (Snohomish PUD and City of Everett 2005). The bull trout present in the lower Sultan River are presumed to be foraging sub-adult or adult fish as it is unlikely that the Sultan River contains any habitat suitable for native char spawning based on temperature and elevation data.

Migratory bull trout are highly picivorous and would most likely be present in association with salmon fry emergence during late winter and spring. They may also feed on eggs during salmon spawning from September through December. No information is available on annual numbers of bull trout that may enter the Sultan River, and they were not observed during the District's 2007 and 2008 juvenile fish surveys in the lower Sultan River (R2 Resource Consultants 2009).

Federal and State Status

The Coastal/Puget Sound bull trout DPS was listed as threatened under the ESA on November 1, 1999 (63 FR 31693) (Table E.6.3-2). This DPS is comprised of all Pacific coast and Puget Sound bull trout populations within Washington State, including the Snohomish River and its tributaries. Although currently listed as threatened under the ESA, the Skykomish River bull trout stock is rated "healthy" by WDFW (WDFW 1998).

Coastal Cutthroat Trout

Coastal cutthroat trout belong to the same genus as Pacific salmon and steelhead, but are generally smaller, rarely over-winter at sea, and do not usually make extensive ocean migrations (Johnson et al. 1999). Like steelhead, they are iteroparous (can spawn more than once before they die) and adults have been known to spawn each year for more than 6 years (Johnson et al. 1999).

Like *O. mykiss*, the life history of coastal cutthroat trout is extremely complex (Johnson et al. 1999, Trotter 1991). Both migratory and non-migratory (anadromous, adfluvial, fluvial, and resident) forms may be present within the same population. Anadromous coastal cutthroat trout, or "sea-run" cutthroat trout, typically spawn in small streams, as do the other life history forms. Unlike juveniles of the lineages that remain in fresh water, anadromous juveniles undergo the morphological, physiological and behavioral changes required for migration and adaptation to saltwater. Non-migratory cutthroat trout typically inhabit a small stream section throughout their lifecycle, whereas freshwater migratory cutthroat migrate within the river system, typically moving to smaller tributaries to spawn. Similar to rainbow trout, resident cutthroat trout (even populations present upstream of natural barriers) can produce offspring that are anadromous.

Juvenile sea-run cutthroat generally rear in streams for 2 or more years, seeking pools and other slow water habitats with root wads and large wood for cover (Trotter 1991). Often coho fry are present in the same habitat, and the larger coho will drive the cutthroat into riffles where they will remain until fall and winter (Stolz and Schnell 1991). Most anadromous juveniles remain in freshwater for 2 to 4 years before smolting and migrating to saltwater, though the range extends from 1 to 6 years.

Local Stock Information

Both resident and anadromous Snohomish stock coastal cutthroat trout are found in the Sultan River basin. The anadromous life history form is present in the mainstem Sultan River and tributaries throughout the anadromous zone (below the Diversion Dam). The resident form is found in Spada Lake (adfluvial life history) and in the tributaries above Spada Lake. Cutthroat trout spawn in the Sultan River from May through July, primarily in low gradient reaches of small tributary streams (Trotter 1991) (Figure E.6.3-6).

Recent fish population surveys completed by the District in the Project bypass reach (OR-3) failed to detect or capture any cutthroat trout (Normandeau and TRPA 2008), even though cutthroat trout are abundant in Spada Lake (Meridian Environmental and Shuksan Fisheries Consulting 2008). All trout counted during the surveys were visually identified as rainbow trout, and genetically sampled trout collected in the bypass reach were all rainbow trout (Normandeau and TRPA 2008).

Results of the Sultan River Juvenile Fish Occurrence, Life History and Distribution study from 2007 and 2008 indicate the highest densities of juvenile trout occurred in July and September in mainstem and side-channel sites (R2 Resource Consultants 2009). The highest density of trout occurred in September.

Federal and State Status

On April 5, 1999, NMFS determined that listing was not warranted for the Puget Sound coastal cutthroat trout ESU. The current WDFW stock status of Snohomish stock coastal cutthroat trout is unknown. Historical abundance information is scarce and generally limited to sport catch, fish trap and dam count data from a few river systems (WDFW 2000). Unfortunately, these data often provide relative rather than actual abundances.

E.6.3.1.2.7 Pacific Lamprey

In Washington, Pacific lamprey are found in most large coastal river systems including the Snohomish River and its major tributaries (Wydoski and Whitney 2003). Like Pacific salmon, Pacific lamprey are anadromous. They hatch and rear in freshwater streams, migrate to the ocean, and return to freshwater as mature adults to spawn. As juveniles, they are filter feeders, using a hood-like flap to filter microscopic plants and animals from above and within the substrate. As adults, Pacific lamprey are external parasites-feeding on the body fluids of various species of fish, using their sucker-like mouths to attach to a fish. In the lower Strait of Georgia and in Puget Sound, Pacific lamprey are a major predator on salmon (Beamish and Neville 1995).

Pacific lamprey spawn in the headwaters of both large and small streams in low gradient, sandy gravel areas upstream end of riffles. Spawning takes place in spring (from April to July) when water temperatures are between 10 and 16°C (50 to 60.8°F). Based on a review of existing literature, no information currently exists describing the abundance and distribution of Pacific lamprey in the Sultan River basin. Results of the Sultan River Juvenile Fish Occurrence, Life History and Distribution study (RSP 5) from 2007 and 2008 did not report occurrence of lamprey (R2 Resource Consultants 2009), although juvenile lamprey are typically buried in the substrate, making observations difficult.

Current stocks of the Pacific lamprey are in a steep decline. In 2003, a group of 11 non-governmental organizations petitioned the USFWS to list four species of lamprey in California, Oregon, Washington, and Idaho as threatened or endangered under the ESA. These four species include Pacific lamprey (*Lampetra tridentata*), river lamprey (*L. ayresi*), Western brook lamprey (*L. richardsoni*), and Kern brook lamprey (*L. hubbsi*). In 2004, the USFWS found that the petition and additional information in their files did not present substantial scientific or commercial information indicating that listing these species would be warranted.

E.6.3.1.2.8 Juvenile Salmonid Distribution and Abundance in the Lower Sultan River

As described in the previous section, the District conducted the Sultan River Juvenile Fish Abundance, Life History and Distribution Study in 2007 and 2008 (R2 Resource Consultants 2008c). The overall objective of this study was to determine the relative distributions and abundance of juvenile salmonids in the Sultan River by life history stages, stream location, and habitat type, using snorkel, electrofishing, and minnow trap surveys. For this, nine juvenile salmonid index sites (Mainstem 1-6 and Side Channel 1-3) were established in the Sultan River; two index sites (Mainstem 5-6) within OR-2 (from Diversion Dam downstream to Powerhouse), while seven (Mainstem 1-4, Side Channel 1-3) were located in OR-1. These sites were selected based on the current extent of anadromous salmonids, the distribution of spawning salmonids, distribution of suspected rearing habitats that included three currently active side channels, site accessibility, and overall habitat representation. The majority of the mainstem index sites (four of six sites) were comprised of combinations of glide and riffle habitat types. For the other two sites, one (Index Site 5) was dominated by pool habitat, and the other (Index Site 6) by rapids. Side channel index sites were comprised primarily of glide and pool habitats.

Snorkel surveys were conducted quarterly (spring, summer, fall) during 2007 and 2008 by a team of five surveyors (4 divers, 1 observer). Each of the nine sites was surveyed three to four times in each survey quarter as stream conditions (i.e., turbidity) allowed. Overall, each site was surveyed a total of 18 times during the study period. Backpack electrofishing and minnow traps were also used in concert with snorkel observations during winter periods when juvenile salmonids typically exhibit daytime concealment behavior and during periods when the Sultan River exhibited elevated turbidity, precluding accurate snorkel observations. Backpack electrofishing and minnow traps also provided additional information in locations that contained areas of dense woody debris and during periods of decreased juvenile Chinook salmon abundance.

During the survey period, over 134,000 juvenile salmonids were enumerated, with the majority observed during the snorkel surveys. Only 1,431 juvenile salmonids were captured during electrofishing surveys and only 162 juveniles in the minnow traps. The results of the study indicated that juvenile anadromous salmonid utilization of habitat varies both spatially and temporally within the two lower reaches of the Sultan River. Highest densities of juvenile salmonids were consistently found in locations that contained numerous woody debris-formed pools and abundant habitat structure (Table E.6.3-4). The two side channels present in Index Sites 1 and 2 supported the highest densities of juvenile fish and both contained abundant cover, wood, and habitat complexity. The highest density of fish (juvenile coho) in the mainstem index sites was found at Index Site 5, which was comprised predominately of pool habitat. In terms of timing, juvenile salmonid abundance peaked during the spring and summer survey periods at a time when newly-emerged salmonid fry (age-0) are present in the river and before age-1+ smolts have moved downstream to the Skykomish River. This pattern was best exhibited with coho salmon, but also occurred with steelhead and to a lesser extent Chinook salmon.

Table E.6.3-4 Snorkel, backpack electrofishing, and minnow trap catch per unit effort indices at six locations on the Sultan River in 2008.

River Mile	Index Site	Snorkel (fish 100m^2)	Electrofishing (fish sec^{-1})	Minnow Trap (fish trap^{-1})
RM 1.5	Mainstem 1	2.58	0.0109	0.067
	Side Channel 1	25.31	0.0661	1.70
RM 1.6	Mainstem 2	2.59	0.0051	0.22
	Side Channel 2	54.30	0.0311	1.48
RM 1.8	Mainstem 3	1.73	0.0147	0.30
	Side Channel 3	9.26	0.0110	0.63
RM 4.6	Site 4	5.10	0.0164	0.50
RM 5.2	Site 5	15.17	0.0185	0.00
RM 9.0	Site 6	2.77	0.0157	0.08

Juvenile coho salmon abundance was dominated by recently emerged fry in the early spring and summer periods and smolt-sized coho in the late fall and winter periods. Juvenile steelhead followed a similar pattern of temporal distribution, while coho salmon distribution appeared to be related to their overwinter habitat selection. Overwintering juvenile coho appeared to select side channel areas with abundant pool and overhead cover in the form of woody debris (e.g., Index Sites 1-2 - Side Channel), while steelhead preferred the deeper mainstem areas that are comprised of rapid habitat types containing instream boulders and generally higher water velocities.

Juvenile Chinook salmon were infrequently encountered during fall and early winter surveys in the Sultan River. In total, over 134,000 juvenile salmonid observations were collected on the lower Sultan River, only two of which were juvenile Chinook observed during the fall survey periods. This suggests that the majority of juvenile Chinook freshwater overwintering takes place downstream in the Skykomish or mainstem Snohomish River.

Juvenile chum and pink salmon fry were observed in the spring and summer periods but only for an abbreviated period (spring periods) when compared to the other species lifestages. Both species occupied similar habitat, preferring the margins of the mainstem sites.

E.6.3.1.3 Macroinvertebrates

In preparation for Project relicensing, the District completed a detailed macroinvertebrate survey at several locations in the lower Sultan River. The survey was performed in the summer of 2005 by District staff, following Washington Department of Ecology Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams (Plotnikoff and Wiseman 2001), and results were analyzed by Aquatic Biology Associates (2005). A previous macroinvertebrate study was conducted by WDG and Eicher Associates, Inc. (1982); however, their results were combined with samples upstream of Culmback Dam and reported as a Sultan River basin total. The raw data from the 1982 study are not available and therefore, cannot be directly compared to the 2005 results from the Sultan River below Culmback Dam. Results from the 2005 survey are summarized in (Figure E.6.3-16). When reviewing these data, note that Benthic Invertebrate Index of Biological Integrity (BIBI) scores usually drop naturally along a longitudinal profile from headwater streams to a river mouth. Overall, these results are similar in trend to rivers within the Puget Sound region, and suggest that the lower Sultan River downstream of Culmback Dam in OR-3 has high biological integrity, moderate biological integrity in OR-2, and lower biological integrity near the mouth of the Sultan River in OR-1.

Benthic Invertebrate Index of Biological Integrity-BIBI (modified Karr 1998)

	Sultan River sample site	RM 0.2		RM 2.7		RM 5.1		RM 9.6		RM 14.3	
	Date	8/8/2005		8/8/2005		8/8/2005		8/8/2005		8/11/2005	
		Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
	METRIC	44	5	45	5	55	5	49	5	52	5
D	Total number of taxa	5	3	9	5	12	5	11	5	9	5
D	Number Ephemeroptera taxa	5	3	5	3	6	3	5	3	11	5
D	Number Plecoptera taxa	4	1	4	1	7	3	6	3	9	3
D	Number Trichoptera taxa	0	1	1	1	4	3	3	3	4	3
D	Number of long-lived taxa	0	1	2	1	3	3	4	5	8	5
D	Number of intolerant taxa	10.35	5	5.56	5	11.23	5	16.55	5	17.93	5
I	% Tolerant taxa	6.56	1	4.82	1	7.78	1	19.41	3	17.25	3
D	% Predator	22	5	23	5	36	5	29	5	38	5
D	Number of clinger taxa	32.07	5	44.99	5	42.57	5	29.55	5	33.11	5
I	% Dominance (3 taxa)										
	TOTAL SCORE		30		32		38		42		44

BIOLOGICAL CONDITION CATEGORY

Categories based on comparison with relatively unimpacted Puget Lowland and Willamette Valley streams.

Maximum score of 50. Each metric scored: 1=low, 3=moderate, 5=high

OTHER COMMUNITY COMPOSITION METRICS THAT ARE INDICATIVE OF BIOLOGICAL CONDITION

	Metric	RM 0.2		RM 2.7		RM 5.1		RM 9.6		RM 14.3	
	Total abundance (m2)	530		460		1491		568		581	
D	EPT taxa richness	14		17		25		22		29	
D	Predator richness	5		7		12		12		19	
D	Scraper richness	10		10		17		12		11	
D	Shredder richness	3		3		3		2		6	
D	%Intolerant taxa	0		0.44		5.25		5.68		8.97	
I	Hilsenhoff Biotic Index	5.5		5.5		4.51		4.59		4.86	
I	%Collector	63.65		64.5		33.13		53.93		50.36	
I	%Parasite	3.79		3.14		4.71		0.71		3.45	
I	%Oligochaeta	14.39		14.13		1.27		1.18		0.92	
I	Number tolerant taxa	8		5		6		4		2	
I	*% Baetis tricaudatus*	2.02		0.8		4.71		13.71		15.86	
I	%Simuliidae	5.05		0.64		8.88		10.41		5.06	
I	%Chironomidae	26.26		39.98		13.95		26		37.7	

L,M & H comparisons with a Pacific Northwest montane stream with high biological integrity.

I= Metric value generally increases with declining biological integrity.
D= Metric value generally decreases with declining biological integrity.

L= Low biological integrity. BIBI scores between 0-24.
M= Moderate biological integrity. BIBI scores between 25-39.
H= High biological integrity. BIBI scores >40.

Source: Aquatic Biology Associates 2005

Figure E.6.3-16 2005 lower Sultan River Benthic Invertebrate Index of Biological Integrity.

E.6.3.1.4 Aquatic Habitat in Spada Lake

Spada Lake is the largest freshwater lake in Snohomish County (Figure E.6.3-17). It is 5.25 miles long with 22 miles of shoreline at full pool (elevation 1,450 feet msl). Spada Lake has a total volume of 153,260 acre-feet and covers 1,908 acres at full pool. Maximum depth is 210 feet and the mean depth at full pool is 82 feet. Three principle tributaries enter the reservoir, the North and South Forks of the Sultan River and Williamson Creek. Williamson Creek and the North Fork Sultan River enter the reservoir on the east end and form shallow coves with numerous snag trees. Many large stumps are also present in these two coves. Many stumps and submerged logs are also present along the reservoir margin. The South Fork Sultan River enters the reservoir at the head of a fairly long narrow arm that extends to the south of the main reservoir body for about 1.3 miles.

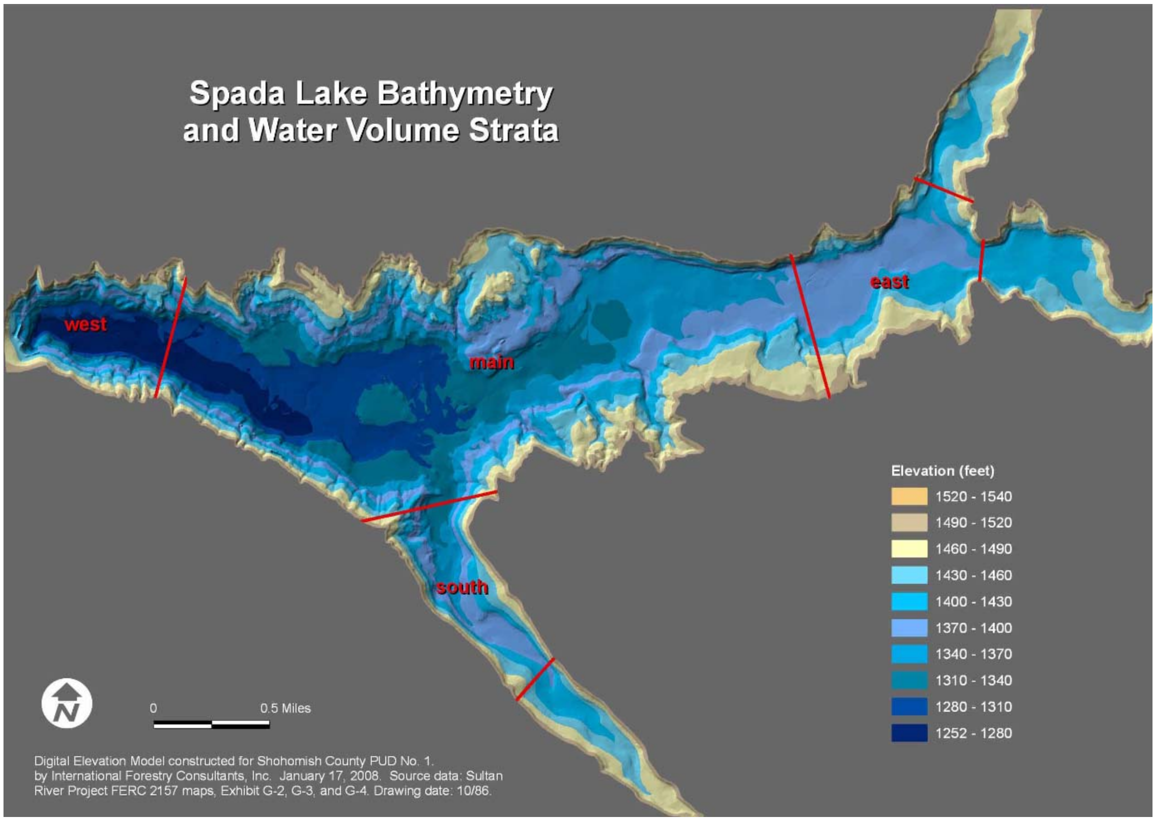


Figure E.6.3-17 Spada Lake bathymetry.

Spada Lake is a rapidly flushing reservoir (approximately three times per year) with low nutrient levels. The reservoir heat budget in 1995 showed it to be a relatively cool lake, below both median and mean values for lakes of similar size, elevation, and latitude (Pfeifer et al. 1998). In addition, the lake is quite turbid in the spring. These factors combine to limit primary productivity, supporting an oligotrophic classification. Zooplankton food resources are not abundant and are reflective of an oligotrophic system. Low phytoplankton production is the limitation to zooplankton (and benthos) food shortages (Pfeifer et al. 1998).

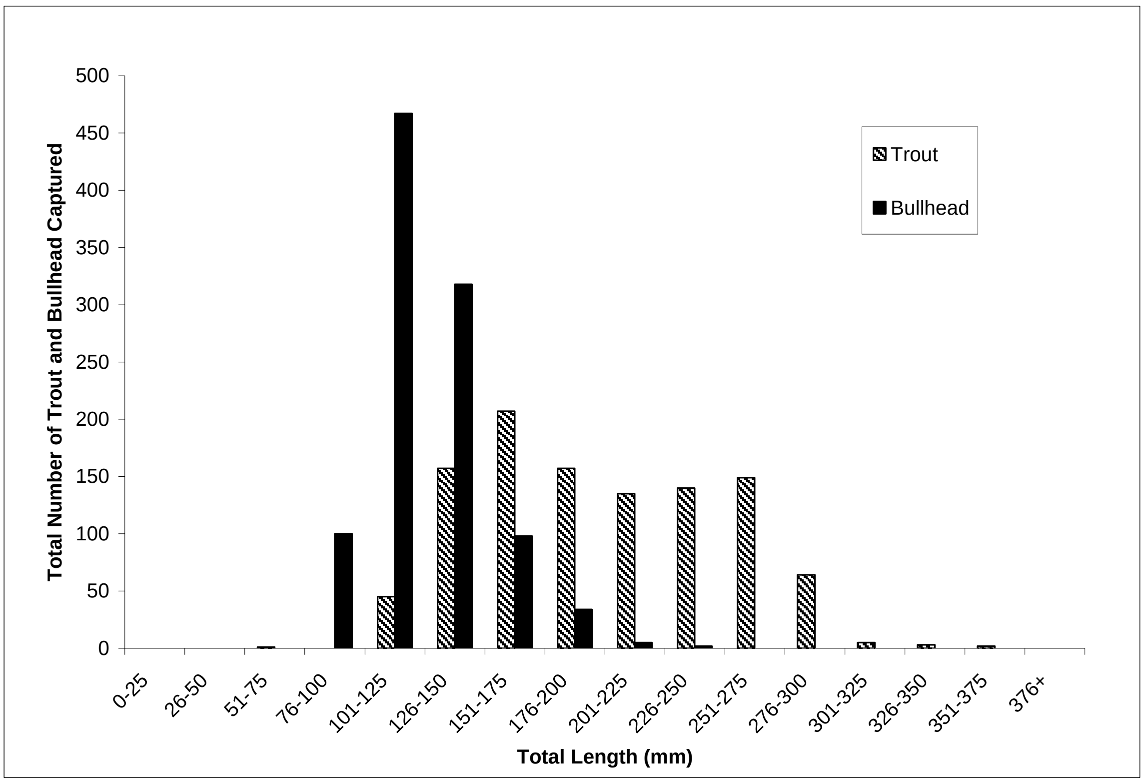
E.6.3.1.5 Aquatic Biota in Spada Lake

Monthly gill net sampling was conducted in Spada Lake from April 25 through November 20, 2007 as part of the Spada Lake Trout Production Study (Meridian Environmental and Shuksan Fisheries Consulting 2008). Fish species documented in the lake included all those previously described in Pfeifer et al. (1998), including rainbow and cutthroat trout and potential hybrids of these two species, and the non-native brown bullhead and brook trout. Meridian Environmental and Shuksan Fisheries Consulting (2008) also documented the presence of large scale sucker in Spada Lake.

E.6.3.1.5.1 Trout and Brown Bullhead Population Metrics in 2007

The following information is summarized from the Spada Lake Trout Production Study (Meridian Environmental and Shuksan Fisheries Consulting 2008).

Between April 25, 2007, and November 20, 2007, 2,874 hours of gill net sampling effort was expended in Spada Lake, resulting in the capture of 1,073 trout including rainbow trout, cutthroat trout, and potential hybrids of these two species; 2,394 brown bullhead; 21 largescale sucker; and 4 brook trout. Trout captured during this sampling period ranged from 101 to 375 millimeters (mm) in length (Figure E.6.3-18). Approximately 99 percent were less than 300 mm. Brown bullhead ranged from 83 to 242 mm in length, but 85 percent were less than 150 mm (Figure E.6.3-19). *Diphyllobothrium* parasite load was estimated in a subsample of captured trout, indicating a high percentage of the trout in Spada Lake have some level of parasite infection. Only 28 percent of the 476 trout dissected had no visible parasites. The rate of occurrence and parasite load was higher in larger trout.



(Meridian Environmental and Shuksan Fisheries Consulting 2008).

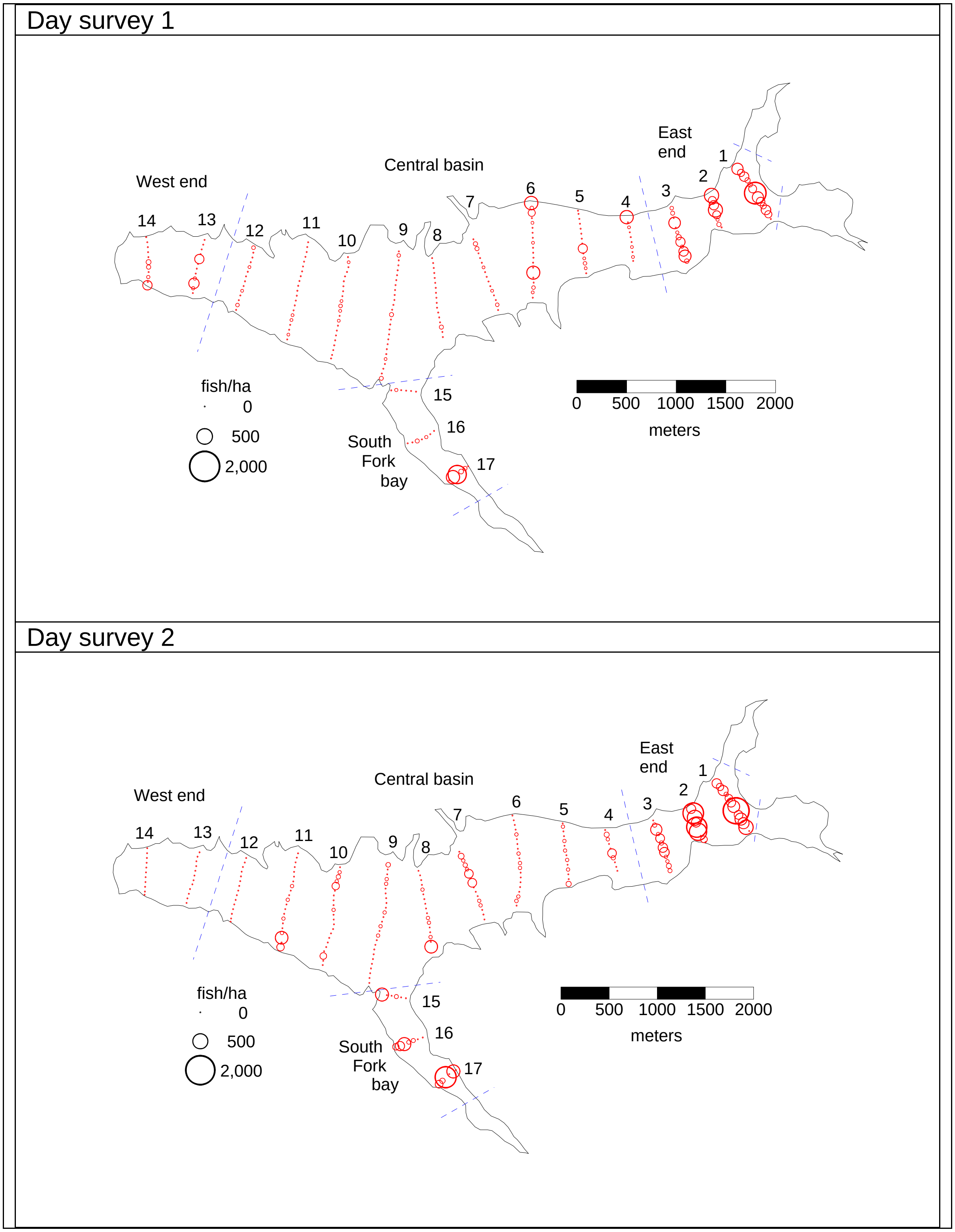
Figure E.6.3-18 Length frequency distribution of trout (cutthroat, rainbow, and potential hybrids combined) and brown bullhead captured in Spada Lake from April through November, 2007.

(Source: Meridian Environmental and Shuksan Fisheries Consulting 2008).

Figure E.6.3-19 Photograph of monthly gill net sampling in Spada Lake (note the abundant brown bullhead in the net).

Mobile hydroacoustic surveys of Spada Lake in 2007 estimated the daytime population of all species combined to be 29,130 fish with a 95 percent confidence interval of ±33 percent (19,455 to 38,815 fish). Of these, 61 percent occurred in the east end of the lake, with the remainder about evenly divided between the central basin and the South Fork Sultan River bay (Figure E.6.3-20). Only 2 percent of all fish occurred in the west end of the lake (near Culmback Dam). In all areas of the lake, most fish (98 percent) occurred in the upper 15 meters (approximately 50 feet) of the water column. Of the daytime population estimate, 20,449 fish were 200 mm long or less, and 8,681 fish were over 200 mm. Most of the small fish were bullhead (74 percent), while most of the large fish (91 percent) were trout.

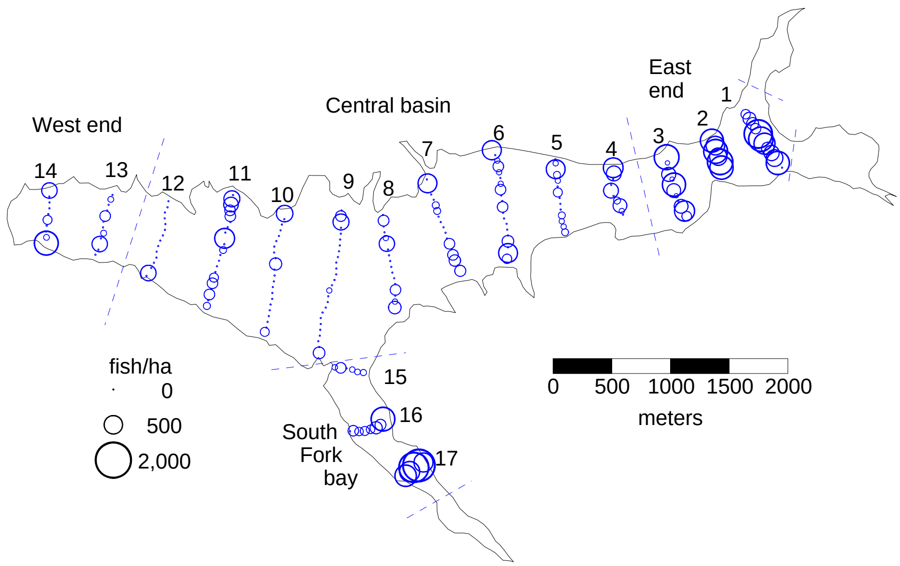
The nighttime acoustic population estimate of all species combined was 78,214 fish with a 95 percent confidence interval of ± 27 percent (57,198 to 99,229 fish). Fish were more evenly distributed among lake sections at night than during the day; however, most (75 percent) occurred in the east end and central basin (Figure E.6.3-21). Similarly, most fish (98 percent) occurred in the upper 15 m (approximately 50 feet) of the water column. Of the nighttime population, 79 percent were estimated to be 200 mm long or less, and 16,581 were over 200 mm. Most of the small fish were bullhead (87 percent), while most of the large fish (83 percent) were trout. At night, bullhead made up over 80 percent of the small fish in all lake sections.



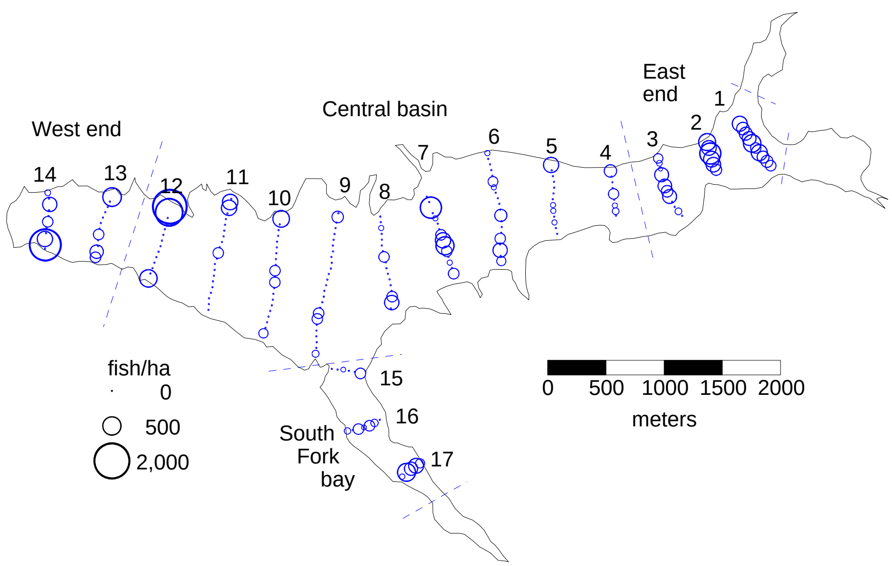
Source: Meridian Environmental and Shukson Fisheries Consulting 2008).

Figure E.6.3-20 Areal fish density (fish/ha) during daytime acoustic surveys of Spada Lake.

Night survey 1



Night survey 2

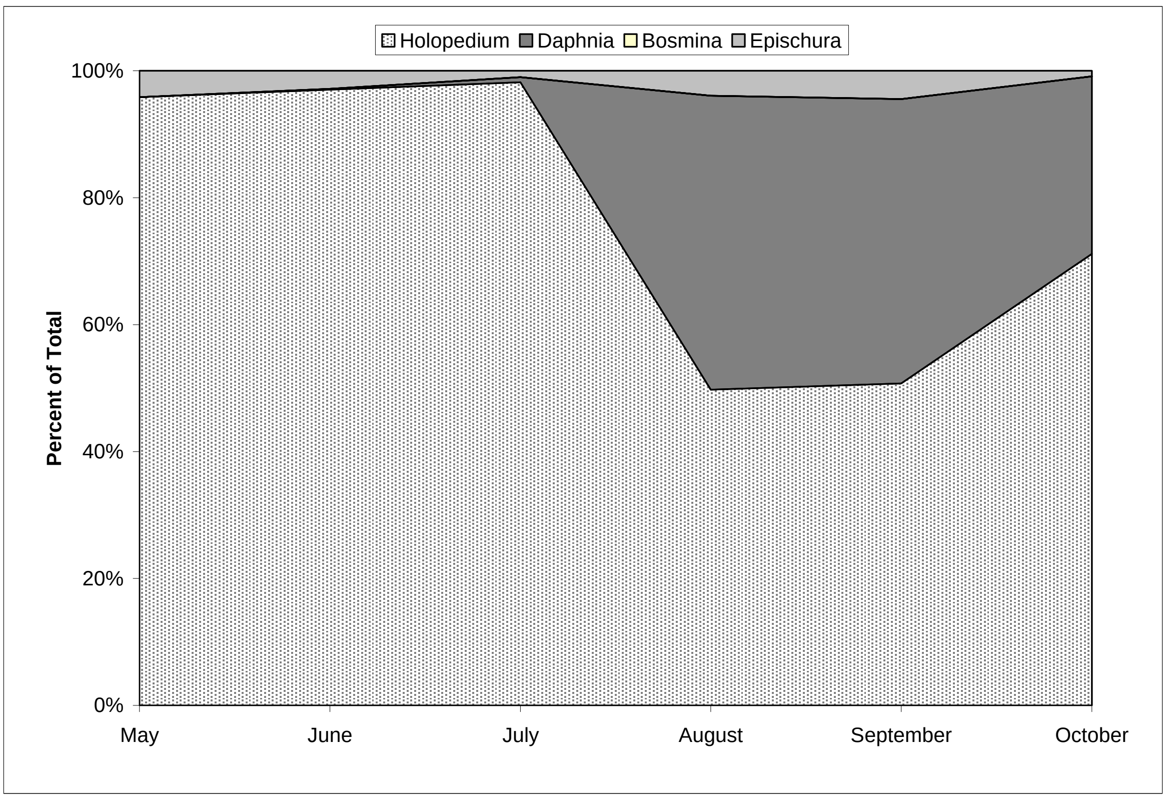


(Source: Meridian Environmental and Shuksan Fisheries Consulting 2008).

Figure E.6.3-21 Areal fish density (fish/ha) during night acoustic surveys of Spada Lake.

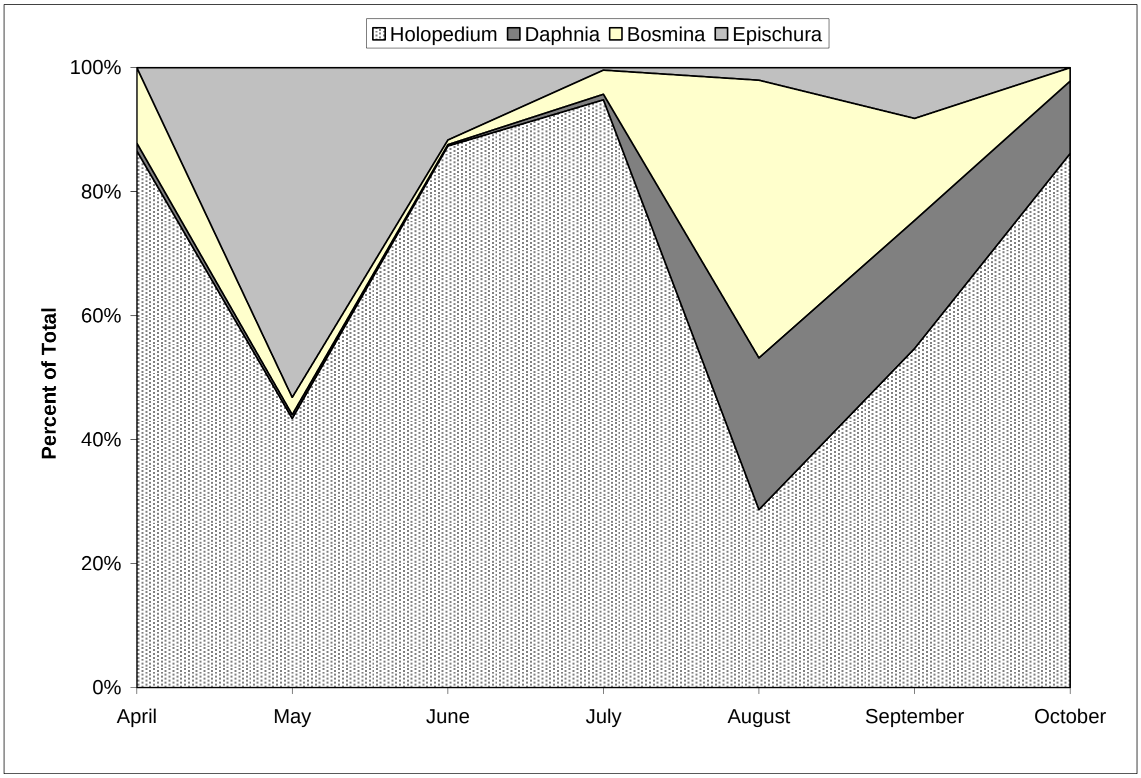
E.6.3.1.5.2 Zooplankton and Neuston Community Structure

Monthly zooplankton sampling in Spada Lake was conducted from May 18 through October 16, 2007 (Meridian Environmental and Shuksan Fisheries Consulting 2008). In general, the number of zooplankton species observed in Spada Lake in 2007 was similar to the number observed during sampling from 1979-1980 (10 and 11, respectively), but far less than the number observed in 1997 (44) (Pfeifer et al. 1998). The most abundant species was *Holopedium gibberum*. Other abundant zooplankton included *Daphnia* and *Epischura*. Peak densities occurred in June, July, and August. The slightly different sampling methods used during the 1997 and 2007 studies make it difficult to directly compare zooplankton densities, but the relative abundances of the most common species can be compared, and have changed dramatically over the past 10 years (Figures E.6.3-21 and E.6.3-22).



(Source: Meridian Environmental and Shuksan Fisheries Consulting 2008).

Figure E.6.3-22 Relative densities (number per cubic meter) of *Holopedium*, *Daphnia*, *Bosmina*, and *Epischura* collected in Spada Lake in 2007



(Source: Pfeifer et al. 1999).

Figure E.6.3-23 Relative densities (number per cubic meter) of *Holopedium*, *Daphnia*, *Bosmina*, and *Epischura* collected in Spada Lake in 1997.

Monthly neuston[20] sampling was conducted from May 10 through October 16, 2007 (Meridian Environmental and Shuksan Fisheries Consulting 2008). The most commonly observed insects in the 2007 samples were Dipterans (flies), Homopterans (aphids and cicadas), Araneids (spiders) and Hymenopterans (wasps, bees, and ants); while the most abundant overall were Dipterans, Hymenopterans, Psocopterans (booklice, barklice or barkflies) and Homopterans. Differences in neuston biomass were observed both spatially and temporally in Spada Lake, and in general, insect biomass densities were greater in the near-shore sampling areas for all orders except Araneida.

E.6.3.1.5.3 Fish Community Dynamics

Based on fish sampling conducted by Pfeifer et al. (1998) and Meridian Environmental and Shuksan Fisheries Consulting (2008), and the bioenergetics modeling conducted by Beauchamp (2008), the following changes have occurred in the Spada Lake fish assemblage from 1997 to 2007:

- The trout population in Spada Lake has decreased slightly and trout greater than 300 mm in length are less abundant.

[20] The group of organisms found on top of or attached to the underside of the surface film of water.

- The brown bullhead population has increased and the overall size class distribution has shifted to smaller fish.
- Brook trout abundance remains very low and confined to the Williamson Creek cove.
- Large scale sucker abundance is probably low, but higher in 2007 than in 1997 as this species was not documented in the Pfeifer et al. (1998) study.
- Based on field data collected in 2007, the bioenergetics model simulations suggest that a combination of warm summer epilimnetic temperatures and a shift to lower energy content prey primarily limit growth and production of trout in Spada Lake compared to periods before and shortly after the reservoir enlargement and inundation of shorelines (i.e., incorporation of substantial organic nutrients) in 1985-1986.
- The most evident change in 2007 growing conditions was the decline in the composite energy density of the diet for trout over time.
- Based on 2007 results, although adult and terrestrial insects are high energy prey, trout must feed in the warm surface temperatures to access these prey during summer stratification. This prolonged exposure to the warmer epilimnetic temperatures increases trout metabolic rates and imposes significant growth penalties on them.
- The loss of energy-rich leeches in 2007 and significant reduction of mayfly naiads in the diet suggest a significant shift in the benthic community, wherein these species have either declined dramatically, or have become spatially or behaviorally inaccessible to trout.
- Predation of bullhead on trout or vice versa was not common in 2007, and fish were very uncommon in trout and bullhead diet samples overall.
- For most of the 2007 sampling period, trout and brown bullhead diets did not overlap, but trout and bullhead both foraged heavily on the same prey (*Daphnia*) during late summer, and therefore, were in direct competition during that time.

E.6.3.1.6 Essential Fish Habitat

The Magnuson-Stevens Act (MSA), as amended by the Sustainable Fisheries Act of 1996, established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a federal fisheries management plan. FERC guidelines require an applicant to identify any EFH in their project area as defined under the MSA and established by the NMFS. EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. EFH consultation with NMFS is required regarding any federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities. The objectives of this consultation are to determine whether the proposed action will adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of federally-managed Pacific salmon: Chinook, coho, and Puget Sound pink salmon (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (PFMC 1999), and longstanding, naturally-impassable barriers (i.e. natural waterfalls in existence for several hundred years). Although not directly identified in PFMC (1999), the historically accessible reach of the Sultan River is EFH for Chinook, coho, and Puget Sound pink salmon.

E.6.3.1.7 Additional Aquatic Species of Interest to the Tulalip Tribe

In a letter dated March 15, 2005, the Tulalip Tribes provided a list of over 50 fish and shellfish species that are important for historical, cultural or spiritual reasons. The Tribes noted that the list incorporates, by reference, all species the state considers as sensitive. The comprehensive list includes numerous marine species that do not occur in the Project vicinity, but identifies eight aquatic species that are known to be present in the Sultan River basin. Section E.6.3.1.2 summarized the life history, habitat requirements, distribution, and abundance based on the available date of those aquatic species important to the Tulalip Tribes that are found in the Sultan River, Spada Lake, and its major tributaries.

E.6.3.2 Project Effects

E.6.3.2.1 Effects on Sultan River Aquatic Habitat

E.6.3.2.1.1 Channel Physical Processes

Sediment Transport (Gravel Quality and Quantity)

As described in Section E.6.3.1.2, salmon, steelhead, and resident trout require an adequate supply of relatively stable, silt-free gravel for successful spawning and egg incubation. Although Spada Lake intercepts gravel from the upper basin and the frequency and magnitude of high flow events in the lower Sultan River are reduced by Project operations, previous and ongoing gravel monitoring studies have shown that gravel quantity and quality are being maintained in the river below the Diversion Dam (Snohomish County PUD and the City of Everett 2005).

Between 1984 and 1994 the District completed a series of studies to determine the effects of Project operations on spawning habitat conditions in the Sultan River below Culmback Dam (Snohomish County PUD 1995a). These studies documented pre-Project gravel conditions in the river and physical changes in the riverbed that were related to post-Project (Stage II) operations.

As described in Snohomish County PUD (1995a), gravel suitable for salmon and steelhead spawning and incubation is distributed in two distinct patterns in the Sultan River below the Diversion Dam. From RM 0.0 to RM 3.3, the river contains a series of glides, riffles and gravel bars. Gravel within and adjacent to the riffles in this relatively low gradient reach is generally suitable for salmon and steelhead spawning and incubation. Between RM 3.3 and RM 9.7, the river is predominantly confined within a steep-walled, relatively high gradient canyon (See Section E.6.3.1.1). Although gravel is naturally limited in the canyon reach, patches of suitable spawning gravel do exist, either near a source (such as a tributary confluence), in small sheltered areas behind boulders, or in pools that are deep and wide enough to decrease shear stress. While this limited amount of gravel is believed to be a major habitat limiting factor, it should be noted that the paucity of gravel in the canyon reach existed prior to Stage II Project operation, and probably prior to Stage I construction of Culmback Dam (Snohomish County PUD 1995a).

The sources of gravel supply and recruitment in the lower Sultan River were also identified by the District through aerial and field reconnaissance of the Sultan River upstream from the mouth to Culmback Dam (Snohomish County PUD 1995a).

> *"Based on the helicopter reconnaissance, it was apparent that the major area of gravel recruitment for the lower Sultan River is located between the Diversion Dam and Culmback Dam. In particular, the north flank of Blue Mountain was observed to be a major source of sediment, along with the south flanks of the Pilchuck-Sultan Ridge. The major source of bed material for the Sultan River lies in the reach of the valley between RM 11.2 and Culmback Dam."*

The sediment is carried to the river by tributary creeks, landslides and debris flows. Sediment sources downstream of RM 11.2 include tributary creeks and occasional landslides that flank the river. Although these sources regularly supply coarse sediment to the river, the rate of supply is believed to be much less than in the area upstream of RM 11.2.

Results of the Sultan River Physical Process Studies (Stillwater Sciences and Meridian Environmental 2008b) confirmed the District's findings and concluded that the present rates and processes of sediment input into the Sultan River below Culmback Dam are similar to pre-Project conditions. Stillwater Sciences (2008) notes:

> *…….the Sultan River is a supply-limited system, with most sediment delivered via mass failures in the gorge reaches above the Diversion Dam and below Culmback Dam. Prior to the inception of Stage I (1964), the Sultan River below RM 16.5 appeared to have received minimal delivery of coarse sediment from the upper watershed. Numerous active slides and debris flows were observed in the gorge; tributary streams did not appear to have contributed significant amounts of coarse sediment to the channel, and there were few sources identified that delivered sediment to the channel downstream of the Powerhouse.*

In 2005, the District contracted with R2 Resource Consultants to collect and analyze spawning gravel samples in the Sultan River, and to compare the results with those from the previous studies (Snohomish County PUD and the City of Everett 2005). Consistent with the previous surveys (described above), the 2005 study resulted in the following conclusions:

- The spawning gravel samples collected in 1982 and 1984, prior to initiation of power generation, were of good quality.
- Under the flow regime in the Sultan River since 1984, the armor layer of gravel deposits in the Sultan River is mobilized about once every 3 to 4 years on average. Scour depth measurements suggest that the armor layer may be mobilized even more frequently than this.
- Except for occasional disturbances associated with gold prospecting activities and potential backwater effects caused by the Skykomish River near the mouth of the Sultan River, the quality of spawning gravels collected in 1987, 1994, and 2005 has remained "good" and is consistent with pre-Project conditions. Historical operations of the Project do not appear to have caused the quality of the spawning gravels to decline.
- The persistent trend of good quality spawning gravels is consistent with observed success of salmon spawning and escapement in the Sultan River downstream from the Diversion Dam.

Although reduced sediment delivery and transport is often a consequence of reduced flood flows at water storage projects, results of Stillwater Sciences and Meridian Environmental (2008b) also suggest that rates of sediment transport remain high enough to convey all of the sediment delivered to the river. This report states:

> *"Present rates and processes of sediment input into the Sultan River in the study area are similar to pre-Project conditions. Flood frequency has decreased, though peak flood magnitudes are only modestly diminished. Results from the mass balance study, which couples sediment transport capacity with estimated rates of sediment input, suggest that rates of sediment transport remain high enough to convey all of the sediment delivered to the river. The upper 13 miles below Culmback Dam has maintained a high sediment transport capacity even with reduced flood magnitudes because of its steep and confined character, which has an inherent excess of sediment-transport capacity. Sediment transport in the alluvial reach in the lower 3 miles of the river has remained high because of narrowing of the channel by vegetation encroachment. Channel narrowing effectively increases the sediment transport capacity, and so sediment delivered from upstream continues to be routed through the reach, despite reduced flood frequency."*

Large Woody Debris

Large woody debris (LWD) (large logs and root-wads) is an important component of stream and river ecosystems. Its presence in a river channel increases aquatic habitat diversity through the formation of pools, meanders, undercut banks, side channels, and backwater areas (Abbe and Montgomery 1996, Montgomery and Buffington 1997). It aids in energy dissipation and in the deposition of spawning gravel. It performs additional ecosystem functions, including trapping sediment and organic debris that can retain nutrients in the ecosystem and influence the development of riparian habitat communities (Bilby and Bisson 1998; Collins et al. 2002). LWD also provides important cover for fish and creates habitat for macroinvertebrates and other aquatic organisms (Lassettre and Harris 2001). In the Pacific Northwest, LWD typically enters river and stream channels through wind throw, bank erosion, and mass wasting, and unless transported by debris torrents or flood flows, remains randomly distributed in the channel.

Except during rare spill events, Culmback Dam restricts the supply and transport of all woody debris from the upper Sultan basin to the lower 16.5 miles of the Sultan River and locations further downstream. The volume of material collected at Culmback Dam varies annually and is comprised of mostly small pieces of wood. Currently, all woody debris that impinges on the dam face is collected and stockpiled onsite. In addition to collecting this material, the District characterizes and sorts it by size, and makes the large wood available for placement at downstream locations within the Snohomish basin.

While Project operations restrict LWD recruitment from upstream of Culmback Dam, woody debris is still supplied to the lower Sultan River system from the heavily wooded gorge located downstream of the dam. As a result, the existing wood loading rate in the upper 13 miles of the Sultan River (below Culmback Dam) is similar to that observed in unregulated rivers in Washington State (Stillwater Sciences and Meridian Environmental, Inc. 2008a) (Figure E.6.3-24). However, much of this wood is small to medium in size and positioned along the channel margins. Consequently, its role in forming complex habitats, especially pool habitats is very limited. This is not surprising, as the canyon reach is relatively confined and has very high transport capacity (Stillwater Sciences and Meridian Environmental, Inc. 2008a). The function of large woody debris in the canyon reach is unlikely to change in the foreseeable future because the surrounding forests consist solely of second- and third-growth timber. The size of the supply of large wood to the system is limited to the size of available trees, and even under regulated flows the stream power is apparently more-than-adequate to displace logs high onto the banks.

Despite having relatively low transport capacity and abundant sediment, the wood loading rate in the lower 3 miles of the Sultan River is substantially less than that observed in unregulated rivers in Washington State. According to Stillwater Sciences and Meridian Environmental, Inc. (2008a), this is likely the consequence of long-term salvage logging dating back to the late 1800s (Collins and Montgomery 2002, Collins et al. 2003).

Whereas the function of LWD upstream of RM 3.0 is unlikely to change in the foreseeable future (due to the channel’s high stream power, confinement, and the small size of available trees), an increase in the quantity of wood downstream of RM 3.0 would likely increase overall physical heterogeneity in that reach (Stillwater Sciences and Meridian Environmental, Inc. 2008a).

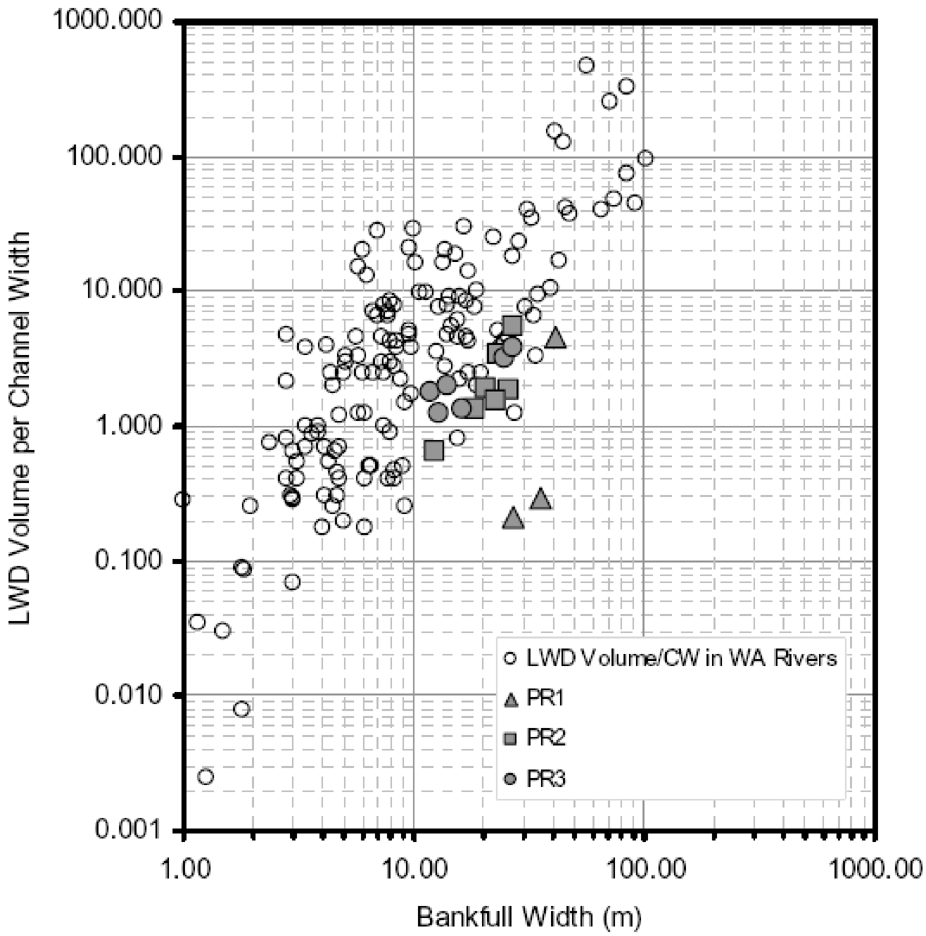


Figure E.6.3-24 Normalized volume of large woody debris vs. bankfull width for Washington rivers (from Fox 2001) and in the Sultan River by process reach.

Channel Maintenance

Channel maintenance in gravel-bed streams requires a range of instream flows that transport bedload sediments through the channel network. Channel and riparian maintenance flows (periodic controlled high-flow releases) are often implemented at hydroelectric projects and other water diversions to remove or “flush” this fine sediment to restore or improve aquatic and riparian habitat. Desired channel maintenance occurs when the prescribed flow regime can transport the quantity and sizes of sediment imposed on the channel without aggrading or degrading the channel over the long term (Schmidt and Potyondy 2004).

While the results of RSP 22 indicate that the lower Sultan River channel planform and position has been essentially unchanged since 1919, reduced peak flow frequencies associated with Stage II operations have decreased the active channel area in the lower 3 miles of the river by approximately 32 percent due to the encroachment of riparian vegetation onto formerly active gravel bars (Table E.6.3-5 and Figure E.6.3-25)

(Stillwater Sciences and Meridian Environmental, Inc. 2008b). In addition, habitats presently defined as side channels are actually relict features (i.e., created prior to Stage I) that were historically part of the active channel.

Table E.6.3-5 Active channel area in acres by year in the lower 4 miles of the Sultan River (i.e., all of PR 1 and the lowermost end of PR 2).

Year	Area (acres)	Year over year change (%)
1957	125	NA
1965	119	4.4
1983	90	24.4
2003	61	32.0

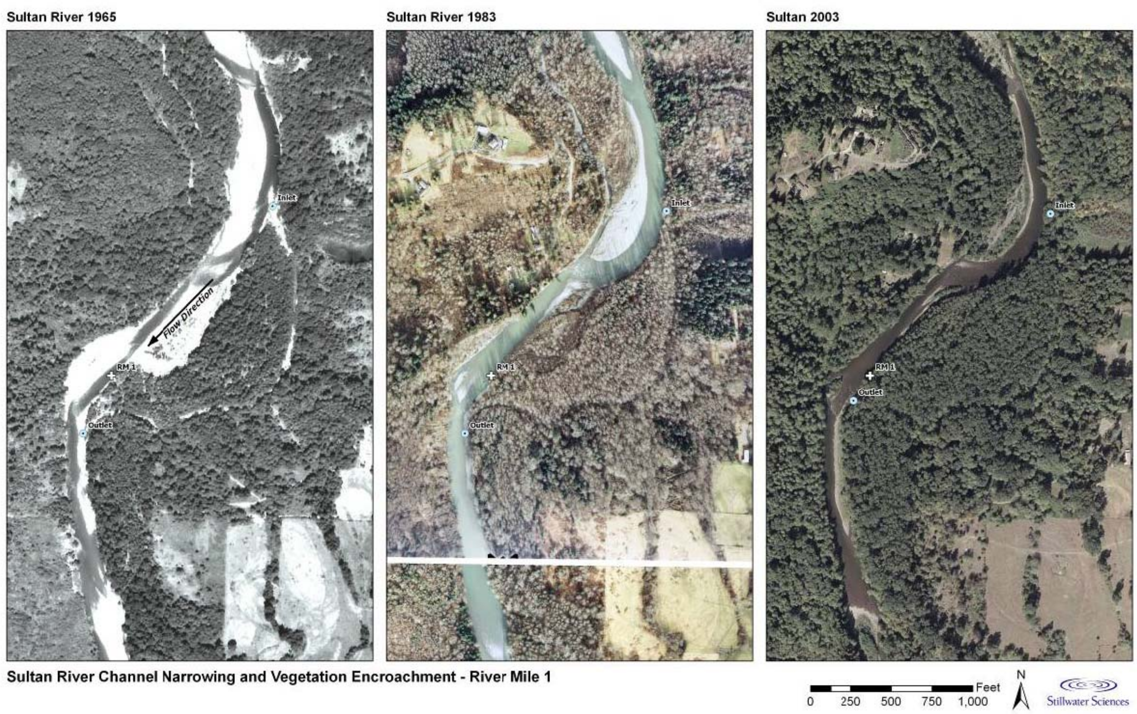


Figure E.6.3-25 Vegetation encroachment of side channel 1 (~RM 0.9) between 1965 and 2003.

Even though most mainstem and side channel vegetation encroachment took place prior to the onset of Stage II operations (Stillwater Sciences and Meridian Environmental, Inc. 2008b), the increased channel stability has likely reduced LWD recruitment and limited the formation and maintenance of side-and off-channel habitats, resulting in an overall decrease in aquatic habitat complexity, particularly in the reach downstream of the Powerhouse (OR-1). The reduced frequency of scouring floods is likely the most important reason the bounding riparian forest has encroached on the channel (Stillwater Sciences and Meridian Environmental, Inc. 2008b).

Side-Channel Habitat

Side channel habitats are generally small watered remnants of major river meanders across the floodplain. They include naturally abandoned river channels, oxbows, flood swales and sometimes the lower ends of terrace tributaries flowing out onto the floodplain. The creation, maintenance, and flow access to off-channel habitat is a dynamic process that changes over time. It is largely controlled by episodic events, primarily major floods.

In many larger stream systems, side channels provide important spawning areas, particularly for chum and coho salmon. They are also recognized for their value as summer and winter rearing habitat for juvenile coho salmon and cutthroat trout. The most productive side channel sites are likely those with year-round fish access, allowing rearing fish to benefit from optimal conditions whether in the main channel or side channel and minimizing the likelihood of stranding if the outlet dries up. Preliminary results of the Sultan River Juvenile Fish Occurrence, Life History and Distribution study (RSP 5) substantiate the importance of these areas as salmonid rearing habitat, particularly for juvenile coho and Chinook salmon, and steelhead (R2 Resource Consultants 2009). Annual escapement surveys have documented the use of side channels for spawning, primarily by chum salmon.

Due to local geology, the floodplain and side channel habitats are naturally limited downstream of Culmback Dam. Most of the river channel is deeply incised in bedrock from RM 3.3 to RM 16.5. All side channel habitat in the Sultan River is within OR-1 (Figure E.6.3-1), an unconfined alluvial floodplain downstream of RM 3.3 (Stillwater Sciences and Meridian Environmental, Inc. 2008a). The confined channel upstream of OR-1 precludes formation of side channels. The total length of side channel habitat is approximately 0.9 miles and accounts for 4.7 percent of the length of all riverine habitat surveyed. Side channel habitat is composed nearly equally of glides (54 percent) and low-gradient riffles (46 percent).

As articulated in the Physical Processes Study, flow regulation and vegetation encroachment have reduced the active channel area and affected the creation and maintenance of side channels in the lower river (Stillwater Sciences and Meridian Environmental, Inc. 2008b). For example, downstream of RM 3.3, the active channel has decreased in width as a result of reduced frequency and magnitude of peak flows resulting from the Project (Stillwater Sciences and Meridian Environmental, Inc. 2008b). Some off-channel habitat in the lower 3 miles of the Sultan River is also periodically disconnected from the river (R2 Resource Consultants 2008b).

E.6.3.2.1.2 Water Temperature

Sultan River below the Diversion Dam (OR-2)

As described in Section E.6.2.1.2.2 water temperatures in the Sultan River below the Diversion Dam are influenced by the amount and depth of water released at Culmback Dam (whether through the intake structure, cone or Howell-Bunger valves, or by spill), by tributary flows, and by meteorological conditions. Moveable panels on the Spada

Lake intake structure control the depth at which water is withdrawn and, hence, the temperature of the water that is delivered to the Powerhouse intake. The degree of temperature control possible by manipulating the intake structure panels varies seasonally with the degree of temperature stratification in the reservoir.

Striving to maintain temperatures within the pre-Stage II range and as close to the mean as possible is designed to ensure suitable conditions for spawning, rearing, and incubation and facilitates compliance with existing state water quality standards. Despite the flexibility provided by the moveable panels, Spada Lake operations under Stage II have resulted in some slight warming in the Sultan River during late-fall and winter (about 0.6°C as measured at the diversion dam) and some slight cooling during the summer and early fall compared with water temperatures observed during Stage I (Snohomish County PUD and the City of Everett 2005). The cooler temperatures often occur during reservoir stratification and generally coincide with the period of salmonid summer rearing. The warmer temperatures occur when the reservoir is isothermal and coincide with salmon spawning and incubation periods during late fall and winter.

While water temperatures in the lower Sultan River generally mimic pre-Project conditions, meet existing state water quality standards and are protective of designated beneficial uses (see Section E.6.2.2.2.1), the slightly warmer water temperatures observed during the late fall and winter have the potential to affect salmon spawning, egg incubation, and emergence timing. As described in Snohomish County PUD and City of Everett (2005), the duration of salmonid egg incubation is largely driven by water temperature and varies with date of fertilization, location in the river and meteorological conditions. Over the past 14 years, the time between fertilization and emergence of Chinook fry in the reach below the Powerhouse has ranged between 78 and 177 days, with a mean duration of 128 days (Snohomish County PUD and City of Everett 2005). In this reach, early spawners emerged after an average of 94 days, whereas emergence for late spawners occurs after an average of 161 days. In the reach between the Diversion Dam and Powerhouse, the time between fertilization and fry emergence ranged between 88 and 214 days, with a mean duration of 152 days (Snohomish County PUD and City of Everett 2005). In this reach, early spawners emerged after an average of 118 days, whereas late spawners emerged after an average of 184 days. The range reported in Healey (1991) is 60 to 150 days.

In all likelihood, there are several potential advantages and disadvantages to short or long incubation periods. With no data available on overall salmon and steelhead survival between early and late emergence in the Sultan River, no conclusions can be drawn about Project-related water temperature effects on salmon and steelhead production. Projects without temperature control have been shown to negatively affect anadromous salmonid incubation and emergence in the Pacific Northwest (i.e., Chinook salmon below Cougar Reservoir on the McKenzie River, OR). However, in the lower Sultan River, overall persistence and in some species, substantially increased production (i.e., pink salmon and naturally produced Chinook) suggest that Project water temperature control is either benign or beneficial to the aquatic community.

Sultan River below Culmback Dam (OR-2 and OR-3)

As described in Section E.6.2.2.2.1, the existing 20 cfs flow release into the Sultan River at Culmback Dam originates from a deepwater valve located at the base of the dam. The temperature of the water at this depth remains a relatively constant 3 to 6°C year round, and as a result, water temperatures at the upper end of OR-3 during the summer are up to 6°C colder than the natural inflow into Spada Lake (CH2M Hill 2009).

Even though the water released from Culmback Dam is very cold year round, water temperature data collected during the summer of 2007 and 2008 indicate that the bypass reach temperatures warm quickly (likely due to the low volume of water and expanse of bedrock present in the canyon). At times, water temperatures at the lower end of the bypass reach are up to 10°C warmer than the water released from the dam and up to 6°C warmer than water released from the Project Powerhouse (CH2M Hill 2009). This rapid longitudinal warming is further illustrated by the fact that the highest 7-DADMax water temperature recorded during the District's 2007 and 2008 water quality monitoring period (16.6°C) was recorded in the lower end of the bypass reach just above the Diversion Dam (at RM 9.8) (CH2M Hill 2009).

While the results of RSP 2 indicate the population of rainbow trout in OR-3 exhibits multiple age classes and appears to be self-sustaining, abundance levels are relatively low compared to other western Cascade streams of similar size, with maximum densities in riffles of 0.23 fish/100 square feet ($ft^{2)}$ (all size classes combined). As noted in Normandeau Associates and Thomas R. Payne and Associates (2008), these low estimated densities may be due in part to difficult sampling conditions and cold water related hiding behavior; however, cold summer water temperatures are also known to limit the recruitment and productivity of salmonids. Under existing conditions, water temperatures in the upper end of the bypass reach during the spring and summer are about 5 to 8°C cooler than those preferred by *O. mykiss* (Reiser and Bjornn and Reiser 1991)[21], and may prolong egg incubation, delay larval development, and retard growth throughout a substantial portion of the reach. However, the water in the bypass reach does warm rapidly during the summer and water temperatures are generally within the preferred range for salmonids near the City's Diversion Dam.

E.6.3.2.1.3 Instream Flows

Operation of the Jackson Project affects the seasonal instream flow pattern in the Sultan River downstream of Culmback Dam. Manipulation of instream flows directly affect the capacity of the Sultan River to support spawning, rearing and other life stages of resident and anadromous fish, while also affecting other physical and biological processes in the river.

As described in Snohomish County PUD and the City of Everett (2005), the existing minimum flow requirements in the Sultan River downstream of Culmback Dam were originally developed in collaboration with the Joint Agencies during the Stage II license

[21] The preferred water temperature for rearing steelhead ranges from 10 to 13°C (50 to 55°F) (Bjornn and Reiser 1991).

amendment process and stipulated in the 1983 Settlement Agreement. The flow regimes were based on several studies of the river below Culmback Dam, including three instream flow/habitat studies (Snohomish County PUD 1980, Easterbrooks and Gerke 1978, and Magee 1967), a fish production model, a river water temperature study conducted below Culmback Dam, and an operations simulation model.

Below Culmback Dam (OR-3)

During the summer of 1980, as part of the baseline studies undertaken for the construction of the Stage II hydroelectric project, the District completed a cooperative instream flow study in the Sultan River between the Diversion Dam and Culmback Dam (RM 9.7 to RM 16.5) (Snohomish County PUD 1980b). The primary objective of the study was to evaluate fish habitat availability for selected species and life stages in response to incremental changes in river discharge, and to compare historic river discharges to those expected under proposed Project operations. The technique used in the analysis was the USFWS' Instream Flow Group incremental methodology (Bovee and Milhouse 1978). Habitat availability (weighted useable area, or WUA) was calculated for spawning, fry, juvenile and adult life stages of rainbow trout, cutthroat trout, and winter steelhead trout. The study indicated that, given the limited amount of productive habitat available upstream from the Diversion Dam, increasing discharges by even minimal increments above proposed Project releases (20 cfs) would cause lost power benefits vastly out of proportion to fish production benefits.

Further, following a meeting held on January 14, 1981, the Joint Agencies acknowledged that water released from the outlet of Culmback Dam would necessarily be drawn from the deeper portions of the reservoir and would therefore be colder than either the existing streamflows or the streamflows before Culmback Dam was built. They understood that the low water temperatures (range 3 to 6°C) of releases from Culmback Dam in the amounts necessary for successful spawning and rearing in the available habitat of the bypass reach would impair the growth and survival of steelhead and salmon within the bypass reach as well as below the Diversion Dam.

In general, the existing 20 cfs flow release provides little trout spawning and rearing habitat area near the base of Culmback Dam and only a limited amount of spawning and rearing habitat near the Diversion Dam (Snohomish County PUD 1980). Reach-scale estimates of trout habitat WUA developed as part of RSP 5 (R2 Resource Consultants 2008c) indicate the existing flow release provides 19.5 percent of maximum habitat area for rainbow trout spawning and 26.8 percent of maximum habitat area for rainbow trout rearing at the upstream end of OR-3.

As noted under *Water Temperature* above, the amount and quality of the habitat created by this 20 cfs flow release (and its associated 3 to 6°C year-round water temperature regime near the dam) has resulted in a relatively low abundance of rainbow trout compared to other western Cascade streams of similar size, and may also contribute to the fact that no cutthroat trout were observed in the reach during fish population surveys conducted in 2008 (Normandeau Associates and Thomas R. Payne and Associates 2008).

Below the Diversion Dam (OR-2)

In 1978 and 1979, Washington Department of Fisheries (WDF), Washington Department of Game (WDG), and Eicher Associates, Inc., completed a "useable width" instream flow study in the Sultan River between RM 3.3 and 9.7 (Easterbrooks and Gerke 1978). The primary objective of this study was to determine the spawning and rearing flows needed to protect Chinook and coho salmon and winter-run steelhead trout downstream of the Diversion Dam. Stream depth, velocity, and substrate data were collected along six transects at known Chinook, coho, and steelhead spawning locations (at four different target flows – 200, 150, 100, and 50 cfs). Based on the results of this analysis, WDF determined the optimum Chinook salmon spawning flow to be 175 cfs, and the optimum coho salmon spawning flow to be 108 cfs (as measured at the Chaplain Creek USGS gaging station) (Easterbrooks and Gerke 1978). Steelhead spawning flows were determined to be adequate at 175 cfs and rearing flows for all three species were determined adequate at 100 cfs.

Under existing license conditions, the minimum base flow released at the Diversion Dam (June 16 to September 14 and November 1 to January 15) is maintained at or above 95 cfs (Table E.6.2-1). Summer flows (July and August) have averaged 124 cfs since Stage II operations began in 1984 (Snohomish County PUD and City of Everett 2005). Historically, natural flows above the City's Diversion Dam dropped below this level nearly every year, often down to 50 cfs during the late summer low-flow period. Thus, the required 95 cfs release has increased flows during the low-flow period. The flow increase provided by reservoir storage has been most beneficial for coho salmon and steelhead trout that are rearing in the river at this time of year.

During the Chinook salmon spawning season (September 15 to October 31), minimum flows of 145 to 155 cfs are maintained at the Diversion Dam (Table E.6.2-1). With inflows from tributaries, the desired 175 cfs at the Chaplain gage is achieved. Flows greater than 95 cfs are maintained throughout the egg incubation period to provide suitable flow conditions over Chinook salmon redds.

Minimum flows released at the Diversion Dam are increased to 150 cfs on January 16 and to 175 cfs on March 1 (through June 15) to coincide with steelhead trout spawning and the period of greatest salmonid fry emergence and early rearing (Table E.6.2-1). Additionally, natural inflow between the Diversion Dam and the Powerhouse ranges from about 20 cfs in the driest months to about 100 cfs in the wettest months. Marsh Creek (at RM 7.6) contributes most of the inflow.

The overall effects of this flow regime on Chinook and coho production in the Sultan River below the Diversion Dam are considered to be positive and are discussed in detail in Section E.6.3.2.3. Available data suggest that Sultan River steelhead escapement has declined since regular surveys began in 1993. However, steelhead abundance has also declined throughout the remainder of the Snohomish basin and the escapement goal of 6,500 spawners has not been achieved since 1995. The District's believes that spawning habitat is currently not limiting to Chinook salmon and steelhead populations in the Sultan River. The health of coho runs is inferred from escapement records in the

Skykomish and abundance of juvenile fish observed in the Sultan River (R2 Resource Consultants 2008c).

Below Powerhouse (OR-1)

In 1967, the WDF conducted an instream flow study in the Sultan River mainly to determine fishery needs in the lower 3 miles of the river below the canyon section (Magee 1967). The method used in the study was developed by WDF in the 1950s, and consisted of making discharge measurements at typical spawning sections in the river selected by biologists, and relating these discharge measurements to the depth and mean column velocities with optimum depth range and optimum velocity range criteria as determined for various species. The results of that study indicated that a minimum of 200 cfs and 165 cfs were needed for salmon spawning and rearing, respectively. Because of this, minimum flows below the Powerhouse are maintained above 200 cfs during fall and spring spawning (September 15 to June 15). During the remainder of the year (summer), instream flows are maintained at or above 165 cfs. As discussed in Snohomish County PUD and City of Everett (2005), these flows are, at times, an augmentation to naturally occurring flows.

In addition to the minimum flow requirement of 200 cfs, a high flow ceiling of 400 cfs is imposed from September 15 through October 15. Chinook and pink salmon eggs deposited in the river channel when river flows exceed 400 cfs downstream of the Powerhouse may be at risk of stranding if the Project flows are subsequently reduced to the minimum instream flow requirement for that period (200 cfs). Therefore, the District attempts to avoid increasing river flows above 400 cfs when the majority of fall Chinook and pink salmon spawn (September 15 to October 15). If the Project is operated above this level during the peak spawning period, the District ensures that stream flows provided during incubation are sufficient to protect redds from being dewatered.

Based on 25 years of post-Stage II operational data, the instream flow regime in the lower Sultan River appears to have been successful in both protecting and enhancing Chinook, coho, pink, and chum salmon in the lower Sultan River (see Section E.6.3.1.2). Comparisons of spawner escapement estimates from before and after the hydroelectric facilities began operating in 1984, indicate that the numbers of Chinook, pink, and chum salmon using the Sultan River have increased substantially.

E.6.3.2.1.4 Project-Induced Flow Fluctuations

Rapid changes in river flow associated with hydroelectric project operations have the potential to adversely affect aquatic resources. If water recedes in a project-affected river reach faster than what would occur naturally (due to changes in generation, emergency shutdowns, etc.), adverse effects can include stranding fish in shallow, low gradient gravel bar areas and off-channel habitat; temporary loss of fish habitat or loss of habitat access; and the dewatering amphibians, aquatic insects, and plant life (Hunter 1992). Rapid changes in stream flow also can affect fish behavior leading to reduced spawning success (Bauersfeld 1978).

Numerous studies have shown that juvenile salmonids are particularly vulnerable to stranding (Bauersfeld 1978, 1977; R. W. Beck and Associates 1989; and Stober et al. 1982) because they are relatively poor swimmers, settle along shallow margins of rivers and often occupy interstitial spaces in rock and cobble substrates. Once stranded, they either die from lack of water or, if caught in shallow depressions, become susceptible to avian and mammalian predation and elevated water temperatures. Limits governing the rate, timing, frequency, and amplitude of project-induced river stage changes (ramping rate restrictions) are often implemented at hydroelectric projects to protect fish from these effects (Hunter 1992). In general, ramping rates (usually measured in inches per hour) need to be gradual enough to allow fish and other aquatic organisms to move out of shallow areas without becoming stranded when flows decrease (Hunter 1992).

Ramping Rates

In 1985, 1986, and 1987, the District conducted a comprehensive field study to evaluate the effects of Project downramping on salmon and steelhead fry in the lower Sultan River (Olson 1990). The study, performed during 22 downramp events, consisted of a rigorous examination of both the seasonal and diurnal differences in the susceptibility of fry to stranding at a range of river flows (Olson 1990). The overall objective of the study was to develop a downramping regime that minimized the stranding of juvenile salmon and steelhead trout in the Sultan River while providing flexibility for power production.

Based on the initial results of these evaluations, a provisional lower Sultan River ramping rate regime was developed in consultation with the Joint Agencies and implemented in 1985. Ramping rates varied from 1 to 6 inches per hour depending on season, time of day, and river stage, and with no restriction on the frequency of downramping events. In 1989, the District, in consultation with the Joint Agencies, submitted an amendment to the Project Operating Plan under license article 57 which modified the Spada Lake rule curves to improve fish protection, Project operations, and flood control (58 FERC 62,224 and 76 FERC 62,053). These modified rule curves reduced flow fluctuations in the lower Sultan River and led to the agreement to implement Powerhouse downramping rates ranging from 1 to 4 inches per hour depending on the flow range, season, and time of day (Table E.6.2-2). These rates were acceptable to the District because the Project is not used for load following (i.e., discharges from the Powerhouse to the river do not fluctuate frequently on a daily basis). The USGS gaging station located immediately downstream of the Powerhouse was selected as the point for compliance measurement and correlated with locations downstream where the rate of change in water surface elevation decreases because of the dampening effect of distance, time, and bank water storage.

Downramping rates were not originally established for Project operations at the Diversion Dam because flow changes there were not associated with hydropower production. However, decreases in flow occasionally can occur at the dam as a result of required operational activities such as maintenance and changing of minimum flows. Such activities occur only about two to four times a year. Although no stranding incidents have been documented below the Diversion Dam, the District and the Joint Agencies agreed that a protective ramping rate schedule should be established for this stream reach to reduce the probability of future incidents. The District therefore adopted downramping rates for the Diversion Dam that range from 1 to 6 inches per hour (Table E.6.2-3) (CH2M Hill 2005).

As recommended by WDFW (Hunter 1992), the existing ramping rates in both Project-affected reaches were developed using data collected during a comprehensive site-specific ramping rate evaluation, addressing those species that are most likely to be adversely affected by flow fluctuations. Based on the information presented in Olson (1990) and discussed in CH2M Hill (2005), the District believes that the existing ramping rates are adequate to protect aquatic resources.

Ramping Rate Compliance

Under its existing license, the District continuously monitors downramping rates and reports all variances exceeding the required rates to FERC and the Joint Agencies. Since May 1988, 41 incidents of Powerhouse downramping variance have been reported. Most were the result of equipment failures that caused immediate generation reductions at the Powerhouse.

The effects of rapid downramping incidents on fish depend on the duration and amplitude of flow change, initial river flow, and the season. Most incidents (26 of 41) lasted less than 15 minutes. While it is reasonable to assume that small fish will find temporary refuge in watered pockets during such incidents, it is possible that some stranding mortality also occurs. Most incidents on the Sultan River, however, occurred when emergent Chinook salmon fry were not present. During the recording period, only 10 incidents occurred during the January 1 through May 31 peak Chinook salmon fry period. Of the nine incidents since 1988 lasting longer than 15 minutes, four involved small stage changes (from 0.31 to 3.25 inches). Of the other five longer duration events, two were caused by a rapid plant shutdown (January 9, 1996 and May 26, 2000) resulting from intake gate closure at Culmback Dam. For the January 9, 1996 event, few Chinook salmon fry would have been present (emerged) and the five hour duration was not long enough to adversely affect incubating salmon eggs given the cool water and air temperatures at that time of year. However, on May 26, 2000 and May 5, 2001, some Chinook and coho salmon fry were probably present and vulnerable to the effects of the 28.8-inch and 13.8-inch stage decreases, respectively.

E.6.3.2.1.5 Flow Continuation at the Powerhouse

Under existing operations, each of the Project's two Pelton units periodically shut down for variety of electrical or mechanical reasons to protect equipment or facilities. If the turbines are tripped off due to mechanical/electrical failure or load rejection, a rapid decline in river flow exceeding downramping rate requirements can occur below the Powerhouse, potentially adversely affecting aquatic resources. Over the last 10 years, there have been 10 unplanned Pelton unit shutdowns with varying effects on streamflow and ramping rates (Table E.5.3-6).

Table E.6.3-6 Pelton shutdowns since 1998 for unit or facility protection.

Date	Description	Decrease in River Level and Flow	Units Involved
7/28/98	Tree in line, BPA overreach on N. Line Protection system recalibrated after 2001	6.5 inches/ 292-141 cfs	1
8/3/99	Large lightning storm, BPA bus cleared Protection system recalibrated after 2001	19.6 inches/ 726-119 cfs	1
7/22/00	Lightning storm, BPA overreach on N. Line Protection system recalibrated after 2001	7.44 inches/ 303-134 cfs	1
5/5/01	Tree in line, BPA overreach on N. Line Protection system recalibrated after 2001	13.8 inches/ 761-248 cfs	1
6/13/02	Unit winding temperature sensor System adjusted to allow higher alarms.	6.48 inches/ 1429-1010	1
7/2/03	Operator initiated – mandoor leak Protections in place to eliminate causes.	1.32 inches/ 240-207 cfs	1
5/26/04	Station Service transformer failure	1.92 inches/ 684-600 cfs	1
12/14/06	Powerhouse isolation from rare windstorm caused switch fault in both lines.	24.5 inches/ 1660-396 cfs	2
10/10/07	Faulty switch interrupter with line out for maintenance Switch maintenance program adjusted	3.83 inches/ 335-228 cfs	1
Tunnel Overvelocity Caused Shutdown of Powerhouse			
5/26/00	Trash in trash rack caused overvelocity trip Overvelocity to be moved to eliminate trash rack influence.	28.8 inches/ 1600–235 cfs	2

Conditions causing the shutdowns have been addressed and the cause eliminated or strategies adopted to reduce the impacts of a shutdown. The result is that Pelton unit shutdowns are now rare and usually only one unit is involved. Although events are rare, these shutdowns could negatively affect aquatic resources, through fish stranding and short-term redd dewatering.

E.6.3.2.1.6 Fish Migration

<u>Passage at the Diversion Dam</u>

The City's Diversion Dam has blocked upstream fish passage at RM 9.7 of the Sultan River (Figure E.6.3-26) since its construction in 1930. Even prior to this time the City had constructed various less permanent diversion structures since about 1917. Prior to this time, Chinook salmon, coho salmon, steelhead trout, and cutthroat trout were able to access an additional 6 miles of habitat. To compensate for the lack of fish passage, the City entered into an agreement with the State of Washington in 1918 that provided funding ($6000) to construct a salmon hatchery on nearby May Creek and a steelhead trout rearing facility (Reiter Ponds) on a tributary to the Skykomish River near Gold Bar.

Figure E.6.3-26 The City of Everett's Diversion Dam located at RM 9.7 of the Sultan River.

Restoring anadromous fish production above the Diversion Dam was considered at length by the Joint Agencies during Stage II planning from 1978 to 1981. The effort culminated in a Settlement Agreement in 1983, wherein the Joint Agencies accepted measures to enhance salmon production in the lower Sultan River downstream of the Diversion Dam rather than restoring anadromous fish access above the dam. This outcome relied on several factors (Snohomish County PUD 1983):

- The 6.4-mile reach above the Diversion Dam has a relatively high gradient (averaging 90 feet per mile) and is in a steep-walled canyon. The channel contains mostly bedrock and large-sized bed material with few areas of suitable spawning gravel.

- Before Stage II construction, spawning gravel areas in the canyon were frequently scoured. Because these high flows occurred during the egg incubation period, salmon production in this reach was probably very limited.

- After completion of Culmback Dam Stage I in 1965, water temperatures in the reach above the Diversion Dam became too cold for productive salmon and trout growth (Eicher 1981).

- Providing upstream fish passage likely would have required higher instream flows in the reach above the Diversion Dam. Discharges from Culmback Dam would have contributed to unfavorable water temperatures from March through October for salmonid rearing and egg incubation in the most productive downstream reaches.

- A requirement for higher instream flows above the Diversion Dam for salmonid habitat would have reduced potential power production enough to make the hydroelectric operations infeasible.

In summary, in 1981 the Joint Agencies decided to not prescribe fish passage at the Diversion Dam based on the prospect of greater salmonid production in the lower Sultan River with implementation of the Project's fisheries mitigation plan. That decision also recognized that a requirement for higher instream flows above the Diversion Dam would make the Project economically infeasible.

In Phase 2 of the Fish Passage Assessment, the District again evaluated the feasibility of providing fish passage at the City's Diversion Dam (CH2M Hill 2008b). This study was prompted partly because Puget Sound Chinook salmon and steelhead are now listed as threatened under the federal Endangered Species Act (see Section E.6.3.1.2). Although the Diversion Dam was present before the hydroelectric Project and is not required for its operation, it is the only means that the City of Everett has to meet their water supply demand during temporary outages of normal Project operations or low reservoir conditions.

Estimates of adult anadromous fish production potential for the bypass reach were developed as part of the District's Fish Passage Feasibility Study (Table E.6.3-7)[22]. These estimates reflect approximate average marine survival rates experienced in the last two decades, which have been relatively low compared to those in previous decades (CH2M Hill 2008b). If marine survival rates increase in the future, so would the estimated adult production in the bypass reach. Of the several methods used to estimate production potential for fall Chinook salmon and steelhead trout, the WUA approach provides the most reasonable estimates because it relies on detailed descriptions of site-specific and species-specific habitat and is based on extrapolating (via habitat scaling) 17 years of known production in the Sultan River downstream of the Diversion Dam.

Table E.6.3-7 Estimates of adult Chinook, coho, and steelhead production potential in the Sultan River upstream of the Diversion Dam.

Species	Based on spawning substrate availability	Based on fry rearing habitat availability	Based on WUA spawning habitat at 30 cfs	Based on WUA spawning habitat at 100 cfs
Chinook	58	118	40	150
Coho	NA	735	NA	NA
Steelhead	NA	52	15	35

NA = Estimates not provided in CH2M Hill (2008b).

[22] The analysis of production potential upstream of the Diversion Dam does not consider the Marsh Creek slide as a permanent blockage to upstream fish passage.

It is important to note that the estimates in Table E.6.3.3-7 do not consider the effects of water temperature on the incubation and growth of juvenile salmonids.

Using instream flow modeling, R2 Resource Consultants (2008b) estimated that Stage II conditions in the bypass reach provide, on average, substantially less spawning and rearing habitat for Chinook and steelhead, but somewhat more spawning habitat for chum, coho, and pink salmon compared to Stage I conditions. Pink and chum salmon utilization of OR-3 would be low due to the steep and confined nature of the channel, which is not preferred by these species.

E.6.3.2.1.7 Powerhouse Discharge False Attraction Potential

During Stage II consultations, the Joint Agencies expressed a concern that returning adult salmon could be delayed or injured by "false attraction" at the Powerhouse. To aid the upstream passage at the Powerhouse, a fish berm was constructed immediately upstream. The fish berm concentrates flow in a slot to attract and guide adult fish upstream, particularly during high-flow discharges from the Powerhouse.

To evaluate fish berm effectiveness, the District: (1) trapped and radio/acoustic tagged steelhead trout, (2) conducted spawner surveys above and below the Powerhouse (comparing pre- and post-Project operation redd distribution), and (3) conducted frequent empirical observations of the Powerhouse tailrace area. Study results and subsequent observations indicate that the fish berm performs as intended. No species experience either delay or difficulty in locating the concentrated flow created by the fish berm, and fish migrate upstream without difficulty (Parametrix 1989).

Additionally, the Joint Agencies were concerned about potential injury of adult fish entering the Pelton turbines' discharge draft tubes during periods of high discharge. This potential problem was evaluated using radio-tagged steelhead trout. An electronic monitoring field was set at the mouth of both draft tubes during the fish tagging effort. No tagged fish were recorded entering the draft tubes during the study, nor were injured or disoriented fish observed.

District staff continue to periodically monitor the tailrace for distressed or injured adults, as agreed upon in the final report on fish passage submitted to FERC (Parametrix 1989). No problems have been observed to date and spawner surveys continue to document the distribution of adults and redds in the Sultan River upstream of the Powerhouse. Survey results are reported annually to the Joint Agencies. The District proposes to continue to maintain the fish berm as needed to function properly.

E.6.3.2.2 Effects on Aquatic Resources Upstream of Culmback Dam

E.6.3.2.2.1 Tributary Habitat and Spada Lake Drawdown

Upstream from Culmback Dam, approximately 5 miles of historical tributary habitat is inundated by Spada Lake (FERC 1981). Stables et al. (1990) stated the similar recruitment rates for year-classes spawned before and after Phase II implementation indicated that inundation of stream habitat did not affect trout production to a level distinguishable from naturally induced environmental variation such as might be due to weather. Resident fish passage is unimpaired between the reservoir and tributaries at all operational water surface elevations (Pfeifer et al. 1998). Seasonal water level fluctuations may impair benthic macroinvertebrate productivity in the lower reaches of these streams and in the reservoir drawdown zone. While the seasonal reservoir fluctuations likely reduce macroinvertebrate production in the drawdown zone, the magnitude of this effect is unknown.

E.6.3.2.2.2 Spada Lake Trout Production

As discussed in Section E.6.3.1.4, Spada Lake and the Sultan River upstream from Culmback Dam support naturally reproducing self-sustaining stocks of resident rainbow and cutthroat trout, as well as potential hybrids of these species. In addition, brook trout, largescale suckers, and large numbers of brown bullhead have been documented in Spada Lake (WDG and Eicher Associates, Inc. 1982; Meridian Environmental and Shuksan Fisheries Consulting 2008).

Historically, Spada Lake supported a popular sport fishery for resident rainbow and cutthroat trout and potential hybrids of these two species. Periodic creel surveys conducted on Spada Lake since 1979 show that trout fishing in the mid-1980s, use of bait was allowed, and catch regulation were liberal, was excellent (Pfeifer et al. 1998); however, the fishery deteriorated in the late 1980s and early 1990s after stocking was suspended, use of bait was prohibited, and regulations became more restrictive. By 1995, harvest rates dropped to near zero and angler effort was the lowest on record. Fish population surveys conducted in 1997 and 1998 indicated that approximately one half of all trout present in Spada Lake were rainbows, roughly a third were cutthroat, and about one-fifth were potential hybrids (Pfeifer et al. 1998). Additional potential causes for the decline in the fishery include low productivity due to reduced nutrients (from aging of the reservoir), competition with the large population of non-native brown bullhead, and the high infection rate of trout with *Diphyllobothrium ditremum*.

During the initial stages of Project relicensing, the WDFW requested a study to identify and prioritize factors that are limiting the productivity of the resident trout in Spada Lake and explore management options that promote increased productivity. In their study request, WDFW proposed that the District duplicate studies conducted by WDFW (Pfeifer et al. 1998) and undertake additional research identified in its study. WDFW also suggested that a literature search be performed to evaluate the introduction of other species of plankton and salmonids to Spada Lake.

Because trout are indigenous to the upper Sultan River and have been affected by Project operation, the District conducted this study using a phased approach. In Phase 1 of Spada Lake Trout Production Study, the District contracted with the University of Washington to review existing information and develop an approach to identify factors limiting trout production. In Phase 2, the District contracted with Meridian Environmental, Inc. and Shuksan Fisheries Consulting to collect vertical temperature profile measurements; estimate the abundance of trout and brown bullheads in Spada Lake; and sample zooplankton and neuston in Spada Lake (the sampling approach identified during Phase 1).

The diet, growth, size structure, thermal regime, fish distribution and abundance, and other information collected during Phase 2 was then input into bioenergetics model simulations to explore limits to trout production and evaluate and prioritize factors affecting trout productivity.

Study results show an increased abundance of bullhead, decreased abundance of trout, direct competition for food resources between bullhead and trout, and decreased high energy food items that could be efficiently used by trout during summer reservoir stratification.

During study implementation, some stakeholders speculated about the benefit of introducing mysis (freshwater shrimp) or kokanee into Spada Lake. Dr. Beauchamp of the University of Washington[23] advises against such introductions. Since low lake productivity is the issue, any new species would reduce the pool of food available for existing species when significant diet overlap occurs. Mysid introductions have caused numerous negative ecological effects throughout many western lakes. Kokanee outcompete trout for zooplankton, but would still not have much to eat. The *Daphnia* biomass is relatively low and their peak availability is highly concentrated into the month of August, primarily above the thermocline. Kokanee might be better able to utilize *Holopedium*, but *Holopedium* is not a desirable food source.

During Project relicensing, the District had numerous discussions with the City of Everett regarding fishery management options for Spada Lake. The City of Everett and the Washington State Department of Health are very concerned that the introduction of stocked fish would adversely affect water quality in Spada Lake and both have indicated their desire that fish stocking not be included in any new license for the Project.

E.6.3.2.2.3 Fish Entrainment

As described above, Spada Lake supports a resident fish population consisting of rainbow trout, cutthroat trout, and potential hybrids of these two species. The trout support a recreational fishery that is managed by WDFW as a naturally reproducing population without hatchery supplementation.

Under existing conditions, the Jackson Project intake structure, morning glory spillway, and Culmback Dam outlet valves are unscreened. WDFW and the Tulalip Tribes expressed a concern that trout may be entrained through these several outlet works of Spada Lake and, as a result, trout rearing or migrating in Spada Lake may be entrained into the turbines, pass through the spillway during a spill event, or pass through an outlet valve during normal releases. Any fish that might be entrained would be removed from

[23] Dr. David Beauchamp (professor of Aquatic and Fisheries Sciences at the University of Washington) is a regionally recognized expert on predator-prey interactions, bioenergetics modeling, behavioral ecology, distribution, growth, population dynamics, and food web dynamics, who worked with the District on RSP 16, the Spada Lake Trout Production Study.

the lake population and no longer available for recruitment to the lake population or recreational fishery.

The District subsequently assessed the entrainment potential and impacts on the resident trout population. Phase I of this study consisted of a review of available literature on fish entrainment at other projects having similar structures, fish communities, and operating conditions. This information, coupled with available data on trout behavior and distribution provided in Pfeifer et al. (1998) and Stables and Thomas (1992), was used to characterize the potential for trout entrainment and effects on the trout population and recreational fishery in the lake. Results from the Spada Lake Trout Production Study (RSP 16) also provide valuable current information on trout abundance and distribution near the Culmback Dam.

If the Phase 1 assessment found that entrainment was occurring at a level potentially detrimental to the trout population and sport fishery within Spada Lake, the District agreed that it would conduct a Phase 2 entrainment study. Phase 2 would involve sampling outflow from Jackson Project structure(s) identified as likely to entrain fish and deemed safe and feasible to sample.

A summary of the RSP 4 (Phase 1) study results is presented below. Additional details describing the Spada Lake fishery, Project outlet works, reservoir operations, and general entrainment risk factors are available in CH2M Hill (2008a).

Assessment of Entrainment Potential

On the basis of its trout entrainment literature review and on their understanding of environmental conditions and facility operations at Spada Lake, CH2M Hill (2008) determined that the risk of resident trout entrainment at Spada Lake is very low under most conditions currently occurring in the lake. The primary reasons for reaching this conclusion include the following:

- Trout, compared to other species, appear less apt to leave their rearing reservoir, especially if they are naturally produced within the system (i.e., non-hatchery).

- The Powerhouse intake tunnel near Culmback Dam typically withdraws water from a much deeper depth than that preferred by trout in Spada Lake. Results of other entrainment studies clearly indicate the low risk of rainbow or cutthroat trout being entrained at deep intakes.

- The likelihood of density-dependent downstream dispersal is less for trout compared to other species because they tend to be less fecund than most other species, and their young are not produced in the reservoir. The rainbow trout population in Spada Lake is currently limited by a parasite and low nutrients, thus making it less likely that the population is density-dependent (i.e., over-crowded or past its carrying capacity), which may otherwise make fish inclined to leave the reservoir.

- Small subyearling trout are rarely observed in Spada Lake because they apparently remain in the tributary streams for 1 or more years before entering Spada Lake

(Stables and Thomas 1992; Pfeifer et al. 1998). This is important because all studies of other species and the few studies of trout indicate that smaller fish are much more likely to become entrained.

- Seasonal drawdown of Spada Lake is relatively minor compared to many other projects. At the maximum average annual drawdown in late summer (approximate elevation 1,420 feet), Spada Lake retains 67 percent of its full-pool volume.

In summary, the risk of trout becoming entrained into the Powerhouse intake or other outlet structures at Spada Lake appears to be very low based on the results of several recent studies at similar sites coupled with an understanding of what is known about the trout population, physical conditions, and current operations at Spada Lake. The major contributing factors to this general conclusion are: (1) exposure to spillway overflow is very infrequent, (2) the depth of the Culmback Dam diversion tunnel (greater than 200 feet) is far below the range of the resident trout population, and (3) the normal depth of the power tunnel intake structure inlet is approximately 50 feet, a depth at which most trout are not found. The fact that very few small-sized juvenile trout rear in Spada Lake also is a contributing factor because studies elsewhere have shown that larger fish with greater swimming capabilities and perhaps more fidelity to their rearing habitat are much less likely to become entrained. Furthermore, there has been no evidence that trout have been entrained and passed through either the outlet works or the Powerhouse intake structure. Thus, trout entrainment is unlikely to occur at a level great enough to have a substantial adverse effect on the Spada Lake trout population.

After a reviewing the Phase 1 study results, FERC stated in its Study Plan Determinations dated February 5, 2008 and May 14, 2008, “that the existing information (18 CFR §5.9(b)(4) is sufficient to analyze project effects on fish entrainment.” Therefore, further investigation of trout entrainment at Spada Lake (Phase 2) was deemed to be unwarranted.

E.6.3.2.3 Overall Effects on Lower Sultan River Salmon and Steelhead Production

E.6.3.2.3.1 Sultan River Salmon and Steelhead Population Trends

Another approach to determine overall operational effects on populations of salmon and steelhead in the lower Sultan River is to assess abundance trends over time. One might hypothesize that if Sultan River salmon and steelhead abundance declined after Stage II implementation when abundance increased in nearby populations, that the overall cumulative effect of Project operations would be negative. In general, however, anadromous fish populations in the Sultan River have exhibited an increasing trend in abundance under Stage II conditions. For pink salmon, the overall effect of Project operations has been highly beneficial. Winter steelhead abundance estimates in the Sultan River do not appear to closely track other populations in the Snohomish River basin; however, data limitations preclude detailed trend analysis. Coho escapement data are not available for the Sultan River because high flows inhibit accurate counts of adults and redds during their spawning period.

Pink Salmon

The pink salmon spawning escapement trend under Stage II operations has been very positive, and abundance is much greater than under Stage I conditions (Figure E.6.3-10). An important factor contributing to increased abundance is thought to be reduced redd scour resulting from the lower peak flows caused by Project incidental flood control operations. Pink salmon by nature benefit from reduced scour flows because their redds are constructed in small gravel substrates that are easily mobilized under high flow conditions. Pink salmon redds are more easily scoured compared to other larger bodied salmon that bury their eggs much deeper in larger spawning gravels.

Chum Salmon

Chum salmon spawning escapement trends under Stage II operations have been increasing, and abundance is probably greater than under Stage I conditions when few chum were observed in the Sultan River (Figure E.6.3-12). Chum have an overall increasing trend since regular surveys began in 1991. Overall escapement is more stable with less annual variability than in the Snohomish River basin as a whole. Similar to pink salmon, chum likely benefit from conditions that reduce redd scour.

Chinook Salmon

As described in Section E.6.3.1.2.1, Chinook salmon escapement has been increasing in the Sultan River under Stage II conditions. However, hatchery Chinook escapement to the Sultan River confounds the assessment of long-term abundance trends in the Sultan River and Snohomish basin. Since production of fall Chinook at the Wallace River Hatchery was curtailed in 1998, the natural-origin Chinook abundance has increased at a greater rate with less annual variability (Figure E.6.3-8) than suggested by total Sultan River Chinook escapement trends presented in Figure E.6.3-7 (which includes hatchery fish). Chinook salmon also likely benefit from reduced redd scour, but to a lesser degree than pink salmon because they tend to spawn in much deeper water and in larger gravels.

Steelhead Trout

As described in Section E.6.3.1.2.5, the available data suggest that Sultan River steelhead escapement has declined since regular surveys began in 1993. Likewise, steelhead in the Snohomish basin have generally been declining; the escapement goal of 6,500 spawners for the entire Snohomish basin has not been achieved since 1995. Trends in yearly variation between the Sultan River and Snohomish basin steelhead escapement do not closely follow each other and there is considerable variability in yearly Sultan and Snohomish basin steelhead escapements.

E.6.3.2.3.2 Hatchery Steelhead Program

Under the existing license, the District supports hatchery steelhead programs in the Snohomish River system by compensating WDFW for planting roughly 30,000 smolts annually to mitigate for the lost production in OR-3 due to a lack of fish passage at the Diversion Dam. In 2004, the Hatchery Scientific Review Group (HSRG) reviewed all anadromous salmonid hatchery programs in Puget Sound. The Snohomish basin program was considered to operate in a manner consistent with short- and long-term goals. The Hatchery Genetic Management Plan (HGMP) identifies Snohomish summer Chinook as an ESA-listed population that may be incidentally affected by the hatchery program (in terms of nutrient enhancement, predation, and competition). The HSRG did not assess the impact on wild winter or summer steelhead as they were not listed under the ESA at the time of analysis. There is a potential for genetic interaction with naturally spawning winter steelhead, but this potential effect is likely to be insignificant due to differences in spawning time (HSRG 2004). Interactions with naturally spawning summer steelhead are minimized by releasing hatchery fish in the mainstem, well downstream of areas typically used by naturally spawning summer steelhead (HSRG 2004).

E.6.3.2.3.3 Macroinvertebrates

The benthic macroinvertebrate assemblage is an essential component of the food web in aquatic and riparian habitats. This group of bottom dwelling organisms cycle nutrients in the aquatic environment by feeding on algae and organic detritus and by preying on a wide range of small organisms. Benthic macroinvertebrates are also an important food resource for fishes, amphibians, reptiles, birds and mammals. Because of benthic macroinvertebrate abundance, taxonomic diversity and range of responses to changes in their aquatic environment, they are commonly the resident biota used to monitor the quality of water resources throughout the United States (Davis et al. 1996). The composition and abundance of the benthic macroinvertebrate community is influenced by many factors such as temperature, flow, dissolved oxygen, nutrients, habitat structure, and substrate composition.

Flow fluctuations (i.e., ramping) in the Sultan River caused by Project operations can cause direct mortality of aquatic organisms during downramping by dewatering organisms or have indirect and delayed biological effects, such as increasing drift response or reducing invertebrate forage. Flow fluctuations have been shown to reduce benthic macroinvertebrate diversity and total biomass and can change species composition. A study on the Skagit River found that flow fluctuations had a greater adverse effect on the aquatic invertebrate community than a substantial reduction in average flow (Gislason 1985).

Alterations in the annual natural hydrograph caused by hydroelectric projects that store water and vary seasonal releases may contribute to disrupted macroinvertebrate food webs as documented in several northern California river systems (Power et. al. 1996). Shifts in the composition of benthic invertebrates to more predator resistant taxa have been found to occur in regulated river systems, which potentially decreases the energy transfer from algae (i.e., primary production) to fish (Power et. al. 1996). Reduced flow in stream channels lowers current velocity and reduces wetted area, causing the loss of important macroinvertebrate habitats such as side channels (Brusven 1984, Trotzky and Gregory 1974).

LWD plays an important role in controlling channel morphology and trapping organic debris, which is an important forage base for macroinvertebrates. The geomorphic potential of the channel to process wood into features that trap organic debris is often limited by the quantity and size of wood. The quantity and size of wood that can be transported is directly related to peak flow levels and by the abundance and size of trees available in the riparian forest available for recruitment to the channel. Project operations affect peak channel forming flows and thus can influence channel morphology and LWD, affecting the quantity and quality of organic matter that can be retained and used as forage by macroinvertebrates. However, the Project has no control over the abundance and size of riparian trees available for recruitment to the channel.

Water released to the bypass reach is colder than in unregulated conditions for much of the year due to the depth from which it is withdrawn from the reservoir. The life cycles of benthic macroinvertebrates are closely linked with the temperature regimes of the streams and water bodies they inhabit (Lehmkuhl 1972, Ward and Stanford 1979, Petts 1984, Erman 1996). Water temperature affects the growth rates and fecundity of benthic fauna and acts as a cue for egg development, hatching, and emergence of adults. Alterations of the normal seasonal temperature changes can disrupt the timing of these events to varying degrees (Ward and Stanford 1979, Erman 1996).

The 1979-1980 study and the 2005 study showed that macroinvertebrate diversity and abundance decreases in the downstream direction in the Sultan River, a typical pattern in western Washington streams. While such a pattern may be normal, current Project flow releases have reduced wetted side-channel and off-channel habitat, likely reducing macroinvertebrate production, although the community structure may be similar to pre-Project conditions. The existing ramping regime may also reduce macroinvertebrate production. The magnitude of such an effect is unknown, but is probably relatively small because Project ramping is much less frequent than at power-peaking hydroelectric facilities. Cold water releases to the bypass reach probably limit macroinvertebrate production to some degree, and the relatively low abundance of macroinvertebrates found during the 2005 survey suggest that productivity is low. Other factors such as reduced sediment transport and reduced flow may also contribute to low macroinvertebrate levels.

E.6.3.2.4 Salmon and Steelhead Monitoring

Under existing license conditions, the District cooperates with the resource agencies and the Tulalip Tribes to conduct annual salmon and steelhead spawning surveys in the Sultan River. The District's surveys comply with Article 55 of their current operating license, which states that:

> *Licensee shall … study to determine the effects of Powerhouse discharge and flow fluctuations on migration, spawning, and rearing of resident and anadromous trout and salmon populations in the Sultan River.*

The District's spawning surveys follow WDFW procedures and include repeated counts of salmon and steelhead adults and/or redds throughout each species' spawning period, coupled with an annual aerial (helicopter based) count of redds during peak spawning. For pink and chum salmon, the method relies on actual fish counts. For Chinook salmon and steelhead trout, the methods relies primarily on redd counts, supplemented with fish counts. The Sultan River spawning survey index areas include the mainstem (RM 0.0 to 2.7), Chaplain (RM 4.5 to 5.2), Gold Camp (RM 7.0 to 7.3), and the Diversion (RM 9.2

to 9.7). The mainstem index reach is a raft-based survey; the others are pedestrian-based. During each survey, the location of all fish and/or redds is documented, and each redd is marked with survey flagging (to prevent double counting). If high flows or turbidity preclude surveys in the specified time frame, the surveys are performed as soon as conditions allow. During the aerial surveys, a biologist also records the number of redds observed in each index reach as well as in the non-index areas. To facilitate counts, the pilot maintains the slowest airspeed possible at an altitude that provides the best possible view of the river channel. In addition, all flights are scheduled to minimize sampling error by avoiding periods of turbid flow and inclement weather.

Surveys for winter-run steelhead typically begin around March 15 and are performed every 14 days with the assistance of a WDFW biologist. The run typically peaks in late May and extends through the end of June. Chinook and pink salmon (odd year only) surveys are performed every 10 days from September 1 through the end of November. The historical peak of the Chinook run is October 1. Chum and coho surveys are performed using the same procedures described above and extend into December as conditions allow. All survey results are reported to the resource agencies, the Tulalip Tribes, and FERC. Escapement estimates are developed cooperatively with WDFW. These monitoring efforts provide an important knowledge base about salmon and steelhead populations in the Sultan River, and are used to inform management decisions.

E.6.3.3 Proposed Environmental Measures

During Project relicensing, the District conducted numerous studies pertaining to the aquatic resources of the Sultan River. These studies were designed to determine the quantity and quality of habitat available under the current and proposed operations, geomorphic and hydrologic factors involved in habitat creation, habitat utilization by juvenile salmonids, and the feasibility of adjusting the current operating configuration. The results of these studies, coupled with existing information, are the basis for the proposed PM&E measures for the Jackson Project. These measures (discussed below) are intended to minimize the potential adverse effects associated with continued Project operation and to enhance the aquatic habitat over the course of the next license term.

E.6.3.3.1 Establish Aquatic Resource Committee

Issue

Any new license issued for the Jackson Hydroelectric Project would likely include a number of measures designed to enhance aquatic habitat and aquatic biota in the mainstem Sultan River (i.e., process flows, LWD enhancement, side channel enhancement, etc). The design and implementation of these measures has the potential to affect the City of Everett's dependable water supply, ESA-listed fish species, recreational fishing, whitewater boating, public and private property, and other resources and would best be accomplished through the development of a multi-stakeholder oversight committee.

Proposed PM&E

Within 30 days of license issuance, the District proposes to establish and convene an ARC for the purpose of consultation[24] with the District to assist in the implementation of any aquatic resource related license articles that are associated with a new Project license. The District would arrange, administer, and chair all ARC meetings and would provide draft meeting minutes for concurrence by the ARC prior to final distribution. Meeting minutes would include ARC action items, a summary of issues discussed, decisions reached, and member concerns. The District would bear all costs associated with conducting meetings.

Environmental Analysis

Many of the aquatic resource measures that may be implemented in the next license term have the potential to affect multiple resources. For example, changes in the lower Sultan River flow regime (including process flows) are expected to have an effect on salmon and trout distribution and abundance, channel morphology, water temperatures, recreational fishing, and whitewater opportunities. Although the response of individual resources to these measures would be monitored by the District, it would be beneficial to have a multi-stakeholder group to guide implementation of these measures and to ensure integration with regional salmon recovery efforts.

E.6.3.3.2 Modify Minimum Instream Flow Schedule

Issue

Project operations affect instream flows in the Sultan River downstream of Culmback Dam. Instream flows directly affect the capacity of the Sultan River to support fish spawning, rearing, and migration and also sustain the physical and biological processes that they depend on.

Proposed PM&E

The District proposes to modify the existing Sultan River minimum instream flow schedule as outlined in Table E.6.2-1. Changes are proposed in the reach downstream of the City of Everett's Diversion Dam (RM 9.7) and extending to the confluence of Sultan and Skykomish rivers (RM 0.0). Proposed minimum flows in OR-1 would range between 200 and 300 cfs (depending on season and reservoir elevation). Minimum flows below the Diversion Dam (OR-2) (via the new minimum flow release structure) would range between 100 and 200 cfs depending on season and reservoir elevation. No changes to the instream flow schedule are proposed for the bypass reach (OR-3). The year round release of 20 cfs from Culmback Dam would remain unchanged from existing conditions (see Section E.6.3.2). The objectives of this instream flow PME are to protect, mitigate, and enhance fish and wildlife resources, riparian vegetation, and water quality in the Sultan River.

[24] For purposes of this PM&E, consultation or consult means that the District would obtain the views of and attempt to reach consensus among the specified parties or specified committee whenever the Project license requires the District to consult. Consultation shall not mean consultation under Section 7 of the ESA or other federal laws specifically requiring consultation (unless specifically provided).

In addition to maintaining the releases outlined in Table E.6.2-7, the ARC (described above) may recommend a drought release schedule when: (1) the ARC determines that a drought event (as described by the City of Everett 2001 Drought Response Plan) is probable; (2) the release schedule described in this PME requires interim modification to manage water supply during periods of weather related shortages; and (3) the drought release schedule will not undermine the purposes of this PME. Upon such recommendation, the District would notify the Commission and would implement the drought release schedule within 7 days of providing such notice, unless otherwise directed by the Commission.

Compliance with the minimum instream flow schedule outlined below would be monitored at established USGS Gaging Stations (12138160 and 12137800) for component releases for OR-1 and OR-2 and calibrated valve curves for OR-3 component releases. The District would commit to funding the operation or operating these two gaging stations in the lower river downstream of Culmback Dam for the license term. For compliance purposes and to account for monitoring imprecision and flow release equipment variability, the District would be allowed temporary fluctuations of up to five percent of the scheduled flow release as measured at USGS Gaging Station No. 12138160 for OR-1 component releases, USGS Gaging Station No. 12137800 for OR-2 component releases, and calibrated valve curves for OR-3 component releases.

Environmental Analysis

The proposed seasonal allocation of minimum instream flows in the Sultan River (Table E.6.2-7), developed in collaboration with the resource agencies and the Tribe, are based on the habitat flow relationships determined during the District's Instream Flow Study (R2 Resource Consultants 2008b). In OR-1, a 300 cfs minimum flow (at reservoir elevations above 1,420 feet msl) would ensure the availability of approximately 79 to 100 percent of the maximum spawning habitat area for Chinook, coho, chum and pink salmon and steelhead trout (R2 Resource Consultants 2008b). At reservoir elevations below 1,405 feet msl, the District's proposed 200 cfs minimum flow, the lowest proposed minimum flow release in OR-1, would ensure the availability of approximately 58 to 94 percent of the maximum spawning habitat (R2 Resource Consultants 2008b).

Rearing habitat for Chinook salmon and steelhead in OR-1 would be greater than 82 percent of maximum habitat area at a flow of 300 cfs and greater than 66 percent of maximum habitat area at a flow of 200 cfs. For coho salmon, rearing habitat area would be near 71 percent of maximum available in the mainstem because of their preference for lower flows/water velocities; 100 percent of maximum habitat area is available at 80 cfs (R2 Resource Consultants 2008b). The amount of rearing habitat for coho salmon provided within existing and proposed side channel habitats has not been quantified. However, the results of the Juvenile Fish Abundance, Life History, and Distribution study (RSP 5) indicate heavy utilization of side channel habitats by rearing coho salmon.

A habitat time series analysis was conducted to estimate the amount of habitat area for each analysis species and life stage that would occur with the proposed minimum flows in wet, average and dry water years using the modeled daily flows described in Section

E.6.2.3 (R2 Resource Consultants 2009) (Appendix C). The reservoir elevation conservation triggers, which would result in lowering the minimum flow from 300 cfs to as low as 200 cfs, were incorporated in the operational model runs used to generate flows needed to calculate the average habitat area values presented in Tables E.6.3-8 and E.6.3-9. Results of this analysis (under the City of Everett's existing water demand scenario [84 mgd]) show that the District's proposed minimum flows in OR-1 would, in an average water year, slightly increase the amount of spawning habitat area for Chinook by 14 percent and increase spawning habitat for coho, and chum salmon, and for rainbow trout to a lesser degree. The amount of spawning habitat area would remain similar to existing conditions for steelhead and decrease slightly for pink salmon and cutthroat trout (Table E.6.3-8). On average, the amount of juvenile rearing habitat would slightly increase for Chinook, steelhead, cutthroat and rainbow trout, and slightly decrease for coho.

In a wet year, spawning and rearing habitat area would increase or remain similar to existing conditions; except that coho rearing habitat area would slightly decrease (Table E.6.3-8). In a dry year, spawning habitat area would increase for all species. Rearing habitat area would also increase for steelhead and rainbow trout, but would slightly decrease slightly for the remaining analysis species (Table E.6.3-8).

Table E.6.3-8 Habitat area provided in OR-1 under Stage II and proposed PM&E conditions.

Species	Life Stage	Average Habitat Area (ft^2)		
		Stage II	Proposed PM&E	% Difference
Water Year - Wet				
Chinook	Spawning	744,165	758,148	1.9
Steelhead		655,069	655,228	0.0
Coho		332,051	332,124	0.0
Chum		370,739	370,901	0.0
Pink		293,789	309,529	5.4
Rainbow		327,398	327,512	0.0
Cutthroat		86,185	90,389	4.9
Chinook	Juvenile Rearing	498,483	499,619	0.2
Steelhead		589,722	598,776	1.5
Coho		158,968	156,505	-1.5
Rainbow		436,398	440,664	1.0
Cutthroat		355,396	355,707	0.1
Water Year – Average				
Chinook	Spawning	638,733	731,371	14.5
Steelhead		651,252	651,254	0.0
Coho		391,330	407,755	4.2
Chum		488,352	530,135	8.6

Species	Life Stage	Average Habitat Area (ft^2)		
		Stage II	Proposed PM&E	% Difference
Pink		361,500	336,912	-6.8
Rainbow		327,238	329,054	0.6
Cutthroat		101,127	89,679	-11.3
Chinook	Juvenile Rearing	516,653	517,420	0.1
Steelhead		568,617	596,413	4.9
Coho		184,354	174,746	-5.2
Rainbow		441,489	453,100	2.6
Cutthroat		368,142	368,441	0.1
Water Year – Dry				
Chinook	Spawning	825,869	846,228	2.5
Steelhead		651,228	651,560	0.1
Coho		532,527	534,629	0.4
Chum		673,425	675,061	0.2
Pink		323,246	344,896	6.7
Rainbow		319,394	324,597	1.6
Cutthroat		85,365	90,395	5.9
Chinook	Juvenile Rearing	548,192	545,649	-0.5
Steelhead		585,670	603,785	3.1
Coho		196,257	189,213	-3.6
Rainbow		459,873	466,112	1.4
Cutthroat		380,477	379,306	-0.3

In OR-2, the District's proposed minimum instream flows would provide from 90 to approximately 41 percent of the maximum spawning habitat area for Chinook salmon (depending on reservoir elevation and release period)[25] and provide greater than 80 percent of the maximum spawning habitat area for coho, pink and chum salmon (at all flow levels). Spawning habitat area for steelhead would range from 38 percent of maximum at 100 cfs to approximately 68 percent of maximum at 140 cfs (R2 Resource Consultants 2008b). Under conditions of median accretion, spawning habitat area for steelhead in the downstream section of OR-2 would be approximately 90 percent of maximum at 140 cfs. This area corresponds with the highest utilization by spawning steelhead. Rearing habitat for Chinook and coho salmon would be near 80 percent of the maximum. For steelhead, rearing habitat would be approximately 50 percent of maximum, nearly identical to the current regime.

[25] A 200 cfs release from September 15 to October 31 would provide 90 percent of maximum spawning habitat area for Chinook; a 175 cfs release from September 15 to October 31 would provide 81 percent of maximum spawning habitat area for Chinook; a 150 cfs release from September 15 to October 31 would provide 70 percent of maximum spawning habitat area for Chinook; and a 100 cfs release would provide approximately 41 percent of maximum spawning habitat area Chinook.

Results of the District's habitat duration analysis for OR-2 show that the proposed minimum flows would, on average, increase the amount of spawning habitat area for Chinook and coho salmon and cutthroat trout and slightly decrease the amount of spawning habitat area for steelhead and rainbow trout compared to existing conditions (Table E.6.3-9). The proposed minimum flows would increase coho salmon juvenile rearing habitat area compared to existing conditions; however, juvenile rearing habitat area would slightly decrease for the remaining analysis species (Table E.6.3-9).

Table E.6.3-9 Habitat area provided in OR-2 under Stage II and proposed PM&E conditions.

Species	Life Stage	Average Habitat Area (ft^2)		
		Stage II	Proposed PM&E	% Difference
Water Year – Wet				
Chinook	Spawning	470,483	508,784	8.1
Steelhead		428,716	380,695	-11.2
Coho		364,692	362,493	-0.6
Pink		373,686	373,686	0.0
Rainbow		183,362	170,617	-7.0
Cutthroat		93,271	100,328	7.6
Chinook	Juvenile Rearing	555,593	544,865	-1.9
Steelhead		474,629	452,810	-4.6
Coho		288,965	294,800	2.0
Rainbow		415,158	406,836	-2.0
Cutthroat		399,429	396,502	-0.7
Water Year – Average				
Chinook	Spawning	454,008	496,859	9.4
Steelhead		436,415	395,714	-9.3
Coho		416,133	417,388	0.3
Pink		445,501	445,501	0.0
Rainbow		182,713	170,073	-6.9
Cutthroat		92,307	99,337	7.6
Chinook	Juvenile Rearing	556,023	545,790	-1.8
Steelhead		460,348	436,859	-5.1
Coho		299,249	305,196	2.0
Rainbow		410,678	402,284	-2.0
Cutthroat		401,140	398,014	-0.8
Water Year – Dry				
Chinook	Spawning	438,647	486,820	11.0
Steelhead		435,781	400,826	-8.0

Species	Life Stage	Average Habitat Area (ft²)		
		Stage II	Proposed PM&E	% Difference
Coho		433,206	430,203	-0.7
Pink		444,702	444,702	0.0
Rainbow		183,305	171,299	-6.5
Cutthroat		91,097	98,248	7.8
Chinook	Juvenile Rearing	559,349	545,960	-2.4
Steelhead		448,064	422,367	-5.7
Coho		303,930	314,426	3.5
Rainbow		408,216	398,039	-2.5
Cutthroat		402,917	399,464	-0.9

In an average water year, habitat area estimates for both OR-1 and OR-2 combined would results in a 12.4 percent increase in Chinook salmon spawning habitat (Appendix C). Spawning and rearing habitat area for all other species would remain similar to existing conditions (within ±4 percent for all analysis species).

While changes in the amount of spawning and rearing habitat area in OR-1 and OR-2 associated with the proposed minimum instream flows generally would be less than ±15 percent for most analysis species, the significant increase in minimum flows in OR-1 would substantially improve connectivity to available side channel habitat in the lower Sultan River. Furthermore, side channel habitat would increase through habitat creation (see Section E.6.3.3.7). Side channels in the lower alluvial portion of the Sultan River provide important rearing and to a lesser extent spawning habitat for several species of salmonids (R2 Resource Consultants 2009). Increasing minimum flows to 300 cfs coupled with additional measures to restore year-round side channel connectivity (described below), would increase the availability of off-channel rearing habitat for all analysis species compared to existing conditions and provide and promote the use of these areas as spawning habitat, primarily for chum and pink salmon.

The District would continue to cooperatively operate real time USGS gaging stations at the Diversion Dam (USGS Gaging Station No. 12137800) and immediately downstream of the Powerhouse (USGS Gaging Station No. 12138160) to monitor minimum flow compliance. Any minimum flow excursions recorded at these locations would be reported to FERC and the resource agencies. The District would also determine the cause of each excursion and report any actions taken to correct or avoid recurrences. Under the proposed Operations Plan (see Appendix A) compliance would be based on average daily measurements. Non-compliance occurs if the recorded flow falls below the required minimum by more than 5 percent for more than two consecutive 15 minute recording periods.

E.6.3.3.3 Process Flow Release Plan

Issue

As described in Section E.6.2.2.1.1, the frequency, magnitude, and duration of peak flood flows in the Sultan River have been reduced under Stage II operations. While this flow regulation has allowed the establishment, persistence, and in some cases proliferation of salmon and steelhead below the Diversion Dam, it has also reduced the active channel area and affected the creation and maintenance of side channels in the 3-mile alluvial reach of Sultan River within Operational Reach 1 (OR-1). Specifically, the Physical Processes Study (Stillwater Sciences and Meridian Environmental Inc. 2008b) concluded:

- Vegetation encroachment in the lower alluvial reach has been an unforeseen consequence of flow alteration. Riparian vegetation has reduced the active channel area in the alluvial reach by 32 percent since Stage II operations began.
- Side channels in the Sultan River are relict features, a consequence of vegetation encroachment into formerly active channels of the river.

Although the gravel transported through the lower Sultan River is considered to be good quality for salmonid spawning habitat uses and is mobilized about once every 3 to 4 years (Snohomish County PUD 1995; R2 Resource Consultants 2005), reduced peak flows have decreased habitat complexity in OR-1.

Proposed PM&E

Several stakeholders expressed an interest in additional high flow releases (process flows) to improve channel and aquatic habitat conditions in the lower Sultan River. The District proposes to use the controlled release capacity at Culmback Dam and the Powerhouse to provide these desired flows.

Under this proposed PM&E, the District would establish a water budget of 22,000 acre-feet over the 50-year term of a new license to provide controlled flows to supplement natural accretion flows for channel maintenance. Water released from Culmback Dam pursuant to these process flow releases and any associated downramping would be deducted from the total water budget. Controlled releases from the Powerhouse would not be deducted from the budget.

The District, in consultation with the ARC, would time the process flow releases to take advantage of accretion flows and generation to achieve geomorphic process goals developed during relicensing (i.e., maintain habitat, support margin accretion, and achieve the gravel sorting).

During a planned process flow event, the District would release process flows from Culmback Dam using the existing Howell Bunger and 42-inch slide valves. The combined maximum release capacity of these valves is 2,355 cfs at full pool (1,450 feet msl). The District, in consultation with the ARC, would schedule the process flow releases to avoid exacerbating downstream flooding, and take into account maintenance and real-time aquatic resource (including fish and macroinvertebrates) concerns. The

District would not be required to provide process flows when the District determines a drought event is probable or occurring.

Within 1 year of issuance of the License, the District would file for Commission approval, a Process Flow Release Plan (PFR Plan). This PFR Plan would document how the District would implement a program that would include a total water budget of 22,000 acre-feet over the 50-year license term for periodic process flow releases from Culmback Dam. The PFR Plan would include provisions that describe: (1) the frequency, magnitude, duration, and timing of process flow releases; (2) the ongoing involvement of the ARC in implementing the program; (3) the mechanism for timing process flow releases to coincide with natural rainfall events or with whitewater boating releases (pursuant to Whitewater Boating Flows PME) and Project generation to achieve greater flow volumes, extend the duration, or increase the frequency of releases in desired reaches or habitats; (4) the timing and other restrictions necessary to minimize impacts to aquatic resources, to not exacerbate flooding in the City of Sultan and to prevent against out-of-bank flooding; (5) the method, locations, and schedule for monitoring and measuring process flow releases pursuant to the Plan; and (6) the method and schedule for monitoring the impacts of process flow releases upon aquatic resources.

The District would develop the PFR Plan in consultation with the ARC and allow a minimum of 30 days for ARC members to comment and make recommendations before submitting the PFR Plan to the Commission. When filing the PFR Plan with the Commission, the District would include documentation of consultation, copies of comments and recommendations, and specific descriptions of how comments and recommendations from the ARC are accommodated by the District's plan. If the District does not adopt a recommendation, the filing would include the District's reasons based upon Project-specific information. Upon Commission approval, the District would implement the PFR Plan.

Environmental Analysis

The Jackson Project is currently capable of releasing a maximum of 2,355 cfs at Culmback Dam at full pool, 190 cfs at the Diversion Dam, and 1,300 cfs at the Powerhouse (at full generation). When typical accretion flows are added to the Sultan River below Culmback Dam[26], the combined total flow at the Powerhouse gage can easily exceed 4,000 cfs (without spill). The District has the ability to quickly open the valves at Culmback Dam to respond to intense precipitation or spill events.

Under this proposed PM&E, the water budget of 22,000 acre-feet total would be provided via controlled release events[27]. Uncontrolled spill events (through the morning glory spillway) and high accretion events would still likely occur during the term of a new license, although the magnitude, duration, and frequency of these events are uncertain. The District's controlled release budget allows tailoring of controlled releases around

[26] Accretion flows during November can easily exceed 1,000 cfs during intense precipitation.
[27] A controlled event is the combined release of up to 2,355 cfs through the Howell Bunger and slide valve at the base of Culmback Dam; a controlled event can occur with limited advance notice and can be variable with respect to magnitude and duration.

uncontrolled events and/or sequencing controlled releases with uncontrolled events or high accretion events. The 22,000-acre-foot budget could be used in several ways and is especially amenable to adaptive management, integrating the results of habitat monitoring.

Although the magnitude and duration of process flow releases in the Sultan River would ultimately be determined in consultation with the ARC, the 22,000-acre-foot budget would allow three 24-hour-long full capacity releases (31 hours with downramping) over the 50 year license term. These releases, at 5,000 acre-feet each, would constitute a channel forming release. The releases could be scheduled anytime and sequenced with uncontrolled spill or more likely with natural accretion events to increase their magnitude or duration, if monitoring indicates that is warranted. The remaining 7,000 acre-feet of the overall budget could be used to provide five releases for the purpose of channel maintenance/channel flushing. These releases would likely occur in March or early April and would be coordinated whitewater activities to the extent approved by the ARC. The physical modifications to the lower river (large wood installations, side channel improvements) would be designed to work in concert with the controlled and uncontrolled release programs to achieve the desired habitat objectives. In addition, habitat monitoring would provide information on the effectiveness of the controlled release program and the combined effectiveness of the controlled, uncontrolled, and high accretion events.

Determining the magnitude and duration of channel maintenance and channel forming flows is a critical stage in the channel enhancement design process. In an addendum to the process flow study, Stillwater Sciences (2008b) determined the existing bankfull flow (Qbf) in the Sultan River at the upstream end of OR-1 to be approximately 2,650 cfs (based on the 1.5-year return peak flow). The 1.5-year return peak flow has been identified as a hydrologic estimate of bankfull flow (Leopold et al. 1964, Dunne and Leopold 1978, and Leopold 1994). Castro and Jackson (2001) examined 76 streams in the Pacific Northwest region (Oregon, Washington, and Idaho), and found that the mean recurrence interval for bankfull flow was 1.2 years in the humid areas of western Oregon and Washington, and 1.4 to 1.5 years in the drier areas of Idaho and eastern Oregon and Washington.

According to the literature, significant bedload transport in gravel-bed rivers typically begins at intermediate discharges approaching Qbf (Wolman and Leopold 1957; Carling 1995; Andrews and Nankervis 1995). While the magnitude and duration of the District's proposed channel maintenance flows would ultimately be determined in consultation with the ARC, a controlled flow release approaching 3,655 cfs [28] would exceed the 0.6 to1.0 x Qbf recommended in Schmidt and Potyondy (2004) to achieve Phase 2 sediment transport (i.e., the minimum flow needed for channel maintenance). A 3,655 cfs controlled flow release would also fall well within the calculation [0.8 to 1.6 x Qbf] recommended in Andrews and Nankervis (1995) to transport most of the bedload in an alluvial river over a period of years. Results of the District's 2007 and 2008 tracer rock study (Stillwater Sciences and Meridian Environmental Inc. 2008b) further suggest that

[28] 2,355 cfs released at Culmback Dam and 1,300 cfs released at the Powerhouse.

the onset of sediment transport (i.e., incipient motion) in the lower Sultan River may have been reached at a peak discharge less than 2,950 cfs.

While the District recognizes that its proposed controlled flow releases alone would not likely result in significant changes to the channel form (i.e., would not significantly widen the channel, remove established riparian vegetation, or result in the reactivation of relict side channels), combining the proposed controlled releases with uncontrolled natural high accretion events or spill events would substantially increase the magnitude and duration of the proposed process flows. These higher combined flows (coupled with detailed habitat monitoring) would likely contribute to the formation and movement of physical habitat features including riffles, pools, runs, and point bars (Kondolf and Wilcox 1996); increase LWD and sediment transport; remove interstitial fine sediment from gravels; and maintain connectivity to existing side channels. In addition to initiating significant changes to in-channel habitat, regular process flows are expected to slightly alter the channel form, and limit riparian vegetation encroachment.

E.6.3.3.4 Downramping Rate Conditions

Issue

Although the proposed minimum instream flows and process flows described in Sections E.6.3.3.2 and E.6.3.3.3 would likely benefit aquatic resources in the Sultan River over the long-term, rapid changes in streamflow associated with Project operations have the potential to strand fish and aquatic insects (resulting in immediate or delayed mortality); dewater salmon and steelhead redds, and result in the temporary loss of fish habitat and fish habitat access. In general, the faster the reduction in flow, the more likely fish are to be stranded or adversely affected. Limits governing the rate, timing, and number of Project-induced stage changes are often established at hydroelectric projects to protect aquatic organisms. Different ramping rate requirements are appropriate for different times of the year depending on the life stages present and prevailing flows.

Proposed PM&E

The District proposes to revise three of its existing downramping rate attributes to protect salmon and steelhead fry in the Sultan River downstream of the Diversion Dam (the area subject to Project ramping effects). As described in Section E.6.2.3.2.10, these measures include:

- Continuing current ramping rate requirements at the Powerhouse (as described in Section E.6.2.1.1.2) with the following modifications to Table E.6.2-2:

    1. In the period November 1 to December 31, allow a “night” downramping rate of 6 inches per hour rather than 4 inches per hour in the highest flow range (1,500 to 750 cfs).

    2. Removing the application of footnote "c" from the periods September 16 to December 31. Footnote "c" states:

If river flow prior to downramping has exceeded 1,000 cfs for more than 72 hours, downramping through this flow range (750 to 600 cfs) occurs only after holding flow constant between 750 and 850 cfs for at least 6 hours of daylight and one overnight period.

- Downramping rates for the new flow discharge structure adjacent to the Diversion Dam (as listed in Table E.6.2-3, Section E.6.2.1.1.2) would be included as a PM&E in a new FERC license.

- Limiting the frequency of Powerhouse downramping under conditions when fry are most vulnerable to stranding, as proposed in Table E.6.2-10.

The District would monitor ramping rates on a 15-minute basis using USGS stream flow gages. No one 15-minute downramping value would be half the hourly rate shown in the schedule. No four consecutive 15-minute downramping rates shall exceed the hourly rates shown in the schedule.

Environmental Analysis

Revising Downramping Rates at the Project Powerhouse

Project downramping studies conducted in the mid-1980s (Olson 1990) indicated that some added downramping rate flexibility would be possible in the Sultan River downstream of the Project Powerhouse while still minimizing the probability of stranding salmonid fry. Therefore, the District proposes to increase the November 1 to December 31 nighttime ramping rate from 4 inches per hour to 6 inches per hour at flows ranging from 1,500 to 750 cfs.

Juvenile salmonids, particularly newly emerged fry, are extremely susceptible to stranding mortality owing to their weak swimming ability and preference for shallow-water habitat with cover (Bauersfeld 1978, 1977; R.W. Beck and Associates 1989; Stober et al. 1982; Olson 1990)[29]. In the lower Sultan River, the salmonid fry rearing period generally extends from late January to early June and it is during this period that they would be most susceptible to sudden flow changes.

Information presented in Olson (1990) indicates that no salmonid fry would be present in the Sultan River from November 1 to December 31. Chinook fry emerge from the gravel as early as January (with peak emergence occurring in March) and seem to grow out of the high-risk stage when they reach approximately 50 mm in length, which occurs by late May or early June (Olson 1990). Pink, coho, and chum salmon are known to emerge from the gravel from late-February through May and steelhead fry begin emerging from the gravel in early June (Snohomish County PUD and the City of Everett 2005). As fry would not be present from November 1 to December 31, increasing the ramping rate to 6 inches per hour is not expected to increase standing potential when compared to existing conditions.

[29] Shortly after emergence, salmonid fry tend to seek the calmer, shallow area of the channel near the shoreline and often occupy interstitial spaces in rock and cobble substrates (Hartman 1965; Hillman et al. 1987).

Eliminating Footnote "C" from Powerhouse Downramping Requirements

The District proposes to eliminate footnote "c" from the current downramping requirements at the Powerhouse from November 1 through December 31 when flows range from 1,500 to 750 cfs. Footnote "c" was originally designed to protect juvenile fish stranding by pausing Project downramping for more than 72 hours before downramping through the flow range. This was thought to encourage fish to leave the side channels before connectivity was reduced (thought to occur between 750 and 600 cfs when the original ramping requirements were developed). However, under existing channel conditions, R2 Resource Consultants (2008b) determined that the three largest side channels do not start to dewater until flows drop to about 375 cfs. Furthermore, as described in Section E.6.3.3.7, the three largest side channels would be modified to contain permanent flow at the proposed Sultan River minimum flow levels. Therefore, these side channels would not be dewatered under proposed operations, making footnote "C" unnecessary. In addition, the District believes that juvenile fish would be less vulnerable to stranding during this period due to their larger size.

Limiting Total Powerhouse Downramping Frequency

Natural flow fluctuations can strand fry in off-channel habitats and under normal circumstances, fish populations can sustain small losses several times a year due to stranding. Hydropower facilities can cause much more frequent flow fluctuations than would be expected in unregulated conditions and repeated flow fluctuations can result in substantial population losses.

Normal Powerhouse downramping is a potential source of Chinook salmon fry stranding mortality during and shortly after their emergence from the gravel. Under current license conditions, downramping rates are restricted, but there are no restrictions on downramping frequency. Recognizing this potential impact and the potential for cumulative losses from frequent downramping, the District adopted (in consultation with the Joint Agencies) limitations on the frequency of Powerhouse downramping when fry are most vulnerable to stranding. These conditions include:

- Periods when river flows are less than 750 cfs.
- The time between Chinook salmon fry emergence and May 31 of each year.
- When downramping is being conducted at rates greater than 1 inch per hour (slightly more than 2 MW per hour).

Limiting downramping frequency would impose a total monthly duration limit (16 hours) and seasonal limit (48 hours, January through May) for Project-induced downramping rates of over 1 inch per hour when river flows are less than 750 cfs. This measure is intended to reduce salmon fry stranding potential by integrating several parameters that can influence fry stranding. Parameters include species, life stage, season, critical flow, and downramping frequency and duration.

This limitation equates to approximately 1.4 percent of the typical operating time from January through May. The 48-hour limitation is consistent with the average of the reduced frequency of ramping that has occurred at the Project since the revision of the State 3 rule curve in Spada Lake in 1990. The District adopted this measure in 2005 following ESA consultation and now intends to impose the limitation as a formal license measure. Also, for added protection, no more than 16 hours of the seasonally allotted 48 hours may occur in any one month. The monthly restriction is intended to prevent the over-accumulation of allowable hours and their subsequent use in a single month. Powerhouse downramping frequency during the Chinook salmon fry period would be reported each year in the District's annual operations report, which is submitted to the Joint Agencies and the FERC. As with the ramping and minimum flow compliance record of the District, it is expected that very few, if any, exceedences would occur if this ramping frequency PM&E was made part of the Project FERC License.

Formally Adopting Downramping Rates for OR-2 at USGS Gaging Station No. 12137800

There is less risk of fry stranding in the reaches of the Sultan River below the Diversion Dam than in the reach below the Powerhouse because the channel is incised, gradients are steeper, and fewer gravel bars are present. However, a section of the river above the Powerhouse between RM 4.5 and RM 5.7 contains low gradient gravel bars similar to those downstream from the Powerhouse that have salmonid fry stranding potential. Downramping rates were not originally established in the License for Diversion Dam operations because flow changes there are not associated with hydropower production. However, decreases in flow occur about two to four times a year at the dam as a result of required operational activities such as maintenance and changes in minimum flows. Although no stranding incidents have been documented below the Diversion Dam, the District and Joint Agencies agreed that a protective ramping rate schedule should be established for this reach to reduce the probability of future incidents. Therefore, to protect against potential stranding of salmonid fry, the District adopted downramping rates for the Diversion Dam as an ESA consultation measure in 2005.

The District proposes to construct a new minimum flow discharge structure adjacent to the City's Diversion Dam. The proposed downramping rates would apply to this hydropower Project component.

The District's proposed downramping rates are in general agreement with the WDFW interim ramping rate guidelines (Hunter 1992), and as such, are believed to adequately protect aquatic resources. Formally proposing the downramping rates for the minimum flow release structure along with strict compliance monitoring would continue to afford aquatic resource protection in OR-2 over the term of a new FERC license. Under proposed operations, downramping effects on aquatic resources in OR-2 would be the same as occurs under existing conditions, which is thought to be negligible.

E.6.3.3.5 Powerhouse Pelton Unit Flow Continuation System

Issue

Releases from the Powerhouse (i.e. discharge through the Pelton turbines) largely control flow levels in the Sultan River downstream of RM 4.5. Under existing conditions, if the turbines are tripped off line due to mechanical/electrical failure or load rejection, a rapid decline in flow can occur. Pelton unit shut downs resulting in exceedence of the downramping rate requirements can negatively affect aquatic resources by possibly stranding fish.

Proposed PM&E

The District proposes and is currently proceeding (having heard no disagreement from the stakeholders) to install a governor control system to bypass the flow through individually controlled turbine needle valves to the Sultan River. This measure is expected to greatly reduce the potential for an immediate reduction in Sultan River flow caused by inadvertent turbine shutdown. The District proposes to implement this solution by October 2009.

Environmental Analysis

Since the Jackson Project was constructed in 1984, a variety of circumstances have led to either single or dual Pelton unit shutdowns. While these shutdowns are now rare (the last minimum flow incident that was considered a violation by FERC occurred in 1994), the potential still exists for rapid shutdowns. While not all situations that might create the need for Pelton turbine shutdown can be mitigated (such as a power conduit failure), the probability and frequency for future unit shutdowns would be greatly reduced by implementing this PM&E. The overall effect of this measure would be to nearly eliminate downramping exceedences and releases below the minimum flow regime caused by turbine/generator shutdowns.

E.6.3.3.6 Large Woody Debris Plan

Issue

The delivery and routing of LWD in the Sultan River has been altered by the presence of Culmback Dam. LWD of sufficient size is either not being recruited from the older second growth stands found in the bypass reach or it is recruited but not being delivered from stands upstream of Culmback. As a result, the wood loading rate in the lower 3 miles of the Sultan River is substantially less than that observed in unregulated rivers in Washington State, and much of the LWD is small to medium-size and positioned along the channel margins (Stillwater Sciences and Meridian Environmental Inc. 2008b). Overall, its role in forming habitats (especially pool habitat) is very limited and there is little wood of suitable size to provide the needed structural complexity that would lead to pool formation. Installing sufficiently-sized large woody debris structures in the lower river would reduce stream power and create higher value habitat for resident and anadromous salmonids and other aquatic biota.

A lack of in-channel LWD has also been identified as a major salmonid habitat limiting factor in the mainstem Skykomish and Snohomish rivers. According to the Snohomish River Basin Salmon Conservation Plan (Snohomish Basin Salmon Recovery Forum 2005), mainstem channels in the watershed have low levels of LWD and debris jams, contributing to a lack of pools and side channels. The Conservation Plan also notes that it would take at least 50 years for newly established riparian forests to contribute large woody debris. As a result, structural remedies (engineered logjams and other features designed to increase habitat complexity) are recommended in some locations.

Under existing conditions, LWD entering Spada Lake typically floats downstream and collects in aggregations near the face of Culmback Dam. The volume of material transported to the dam varies annually and is comprised of mostly small pieces of wood; however, larger pieces do occasionally become impinged on the face of the dam. Currently, all impinged woody debris is collected and stockpiled onsite. The District then characterizes and sorts the debris by size, and makes the large wood component available for placement at downstream locations within the Snohomish basin.

Proposed PM&E

During Project relicensing, several stakeholders expressed an interest in enhancing LWD in the lower Sultan River to increase habitat diversity for resident and anadromous fish. Specifically, LWD the restoration goals included:

- Increasing gravel retention on the upstream side of the jam
- Creating pools and cover in the jam vicinity
- Encouraging lateral movement of high flows into side channels and other off-channel habitat
- Increasing habitat complexity

The stakeholders also recommended the District implement a wood management plan in consultation with the ARC that guides in the collection and placement of LWD in mainstem areas and side channels.

Under this proposed PM&E, the District in consultation with the ARC, would develop and implement a Jackson Project Large Woody Debris Plan (LWD Plan). The LWD plan would include provisions to install up to eight LWD structures in the Sultan River between RM 0 and R M16[30]. Up to five of the eight structures would be placed in the main channel and would be designed to improve main channel habitat complexity. The District would design the main channel LWD structures to re-direct flow, carve and create habitat, add diversity, retain and sort sediment, provide salmonid rearing habitat, and/or provide a medium for use by macroinvertebrates. Up to three of the eight structures would be associated with side channels and designed to improve mainstem / side channel connectivity by re-directing flow into the side channel, as reasonably feasible and appropriate.

[30] Subject to gaining regulatory approval and necessary legal access.

Each LWD structure installed pursuant to this PME would include a minimum of five and up to thirty key structural pieces of wood (where possible) and would be designed to collect additional wood over time. Additionally, each key structural piece would be between 24 and 36 inches in diameter at breast height (dbh) and approximately 35 to 40 feet in length with the rootwads intact. The size and length of each structural piece would be limited by the capacity of a truck to move structures to a staging area. Further limitations would be imposed for efforts relying on helicopters to transport structural pieces. The weight of each structural piece may limit aerial transport by Chinook helicopter between the staging area and the Project site. The structural pieces would be one of the following species: fir, hemlock or cedar. Structural pieces greater than 36 inches in diameter (dbh) would be considered subject to availability and the limitations previously described.

In selecting the specific location of an LWD structure, the District would consult with the ARC and consider the probability of structure retention and risk to property. The District would use woody debris from Spada Lake that accumulates between Culmback Dam and the log boom where possible to support the LWD projects described herein and also to provide materials in support of the side channel enhancement projects. When those projects have been completed, the District would transport, if necessary, future accumulations of woody debris the occur between the log boom and the dam and deposit them directly downstream of Culmback Dam. The District would consult with the ARC regarding the movement of materials for direct deposition downstream of Culmback Dam. This program would be discontinued when the District deems, in consultation with the ARC, that LWD quantities are adequate in the Sultan River.

The District would file its LWD Plan with the Commission within 1 year of license issuance. The LWD Plan would document how the District would implement a program including provisions that describe (1) the design and location of each LWD structure; (2) the LWD installation schedule; (3) the timing and other restrictions necessary to minimize adverse impacts to public safety and property; (4) the method and schedule for monitoring the effectiveness of the LWD structures; and (5) the method and schedule for moving woody debris accumulated in Spada Reservoir between Culmback Dam and the log boom to be deposited directly downstream of Culmback Dam.

Environmental Analysis

As described in Section E.6.3.2, the wood loading rate in the lower 3 miles of the Sultan River is substantially less than that observed in unregulated rivers in Washington State. While this is likely the consequence of long-term salvage logging dating back to the late 1800s (Stillwater Sciences and Meridian Environmental, Inc. (2008a), operation of the Project would continue to block the downstream recruitment of LWD.

Whereas the function of LWD upstream of RM 3.0 is unlikely to change in the foreseeable future (due to the channel’s high stream power, confinement, and the small size of available trees), an increase in the quantity of wood downstream of RM 3.0 would likely increase overall physical heterogeneity in that reach, benefiting resident and anadromous salmonids.

In general, LWD provides a number of habitat functions. For example, studies have found that in some river systems, LWD can account for up to 50 percent of sediment storage (Lassettre and Harris 2001). This storage potential can reduce fine sediments in spawning gravels and can also aid in the accumulation of spawning gravels, increasing potential spawning habitat. Increased LWD could also substantially increase nutrients available to the aquatic environment. Trotter (1990) found that reaches containing large wood stored twice as much organic matter as reaches without LWD. Studies have also found that LWD can play a major role in trapping salmon carcasses and ensuring that their marine-derived nutrients are not flushed from the system. Cederholm and Petersen (1985) observed that the distance salmon carcasses traveled downstream was inversely related to the amount of LWD in the stream. These nutrients increase aquatic productivity and ultimately lead to increases in fish production. In addition to the above benefits, LWD structures would directly benefit fish, namely salmonids, because it provides breakwater areas that minimize energy expenditure, provide instream cover and prime areas for food foraging (Lassettre and Harris 2001). Such direct benefits can ultimately increase fish production.

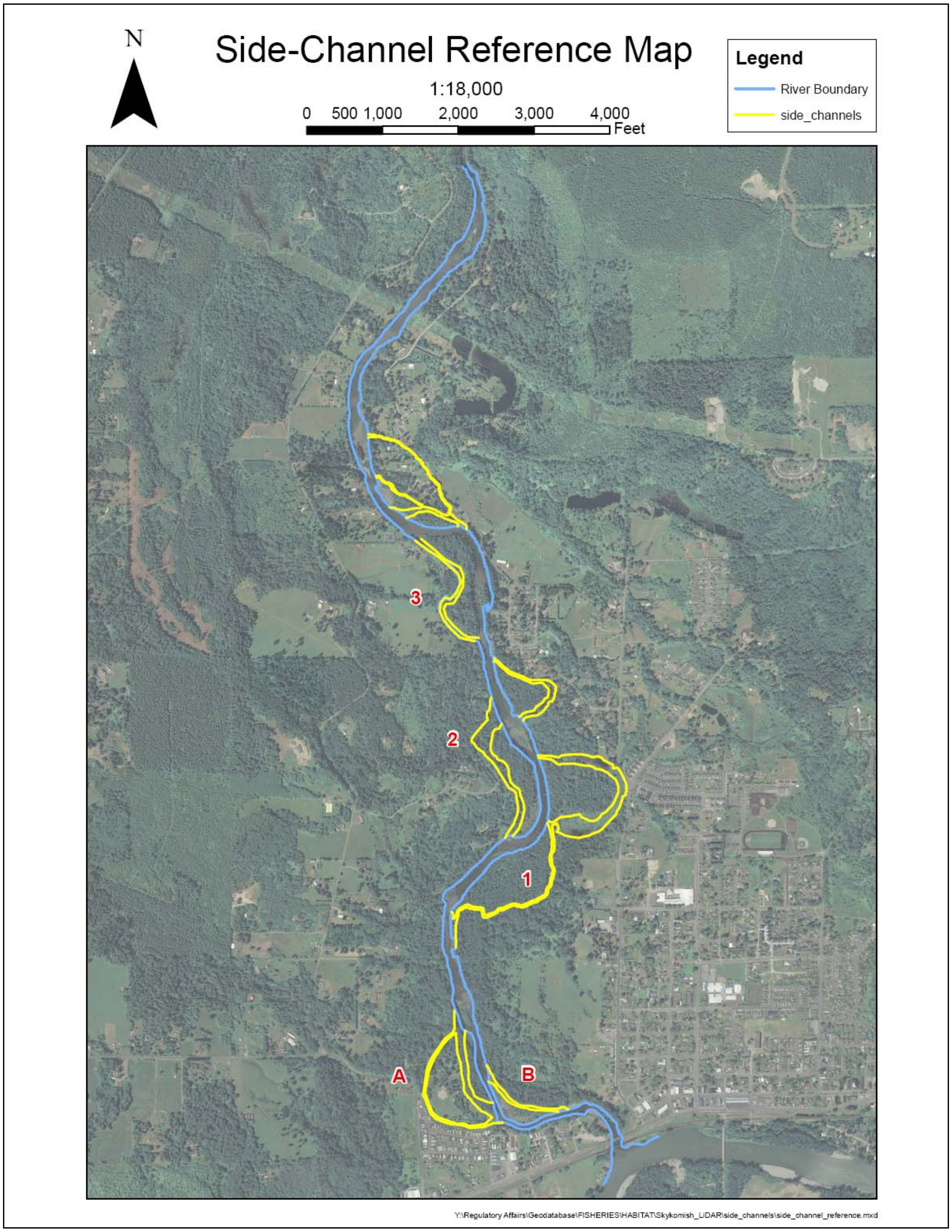
E.6.3.3.7 Side Channel Enhancement Plan

Issue

Side channels in the lower alluvial reach of the Sultan River provide important spawning and rearing habitat for several species of salmonids. Coho juveniles in particular are known to make widespread use of off-channel habitats, often gaining access to small streams and backwater environments that are either inaccessible to adult coho or unsuitable for spawning (Peterson 1982). Side channels are also recognized for their value as summer and winter rearing habitat for cutthroat trout. When regularly and permanently available, side channels also provide high quality protected spawning habitat, especially for coho, chum, and pink salmon. The results of RSP 5 substantiate the importance of these areas as rearing habitat in the Sultan River for coho, Chinook, and steelhead (R2 Resource Consultants 2009). Annual escapement surveys have also documented the use of side channels for spawning, primarily by chum salmon.

As articulated in the Physical Processes Study (Stillwater Sciences and Meridian Environmental 2008b), flow regulation has reduced the active channel area and affected the creation and maintenance of side channels in the lower Sultan River. As a task under the Instream Flow Study (R2 Resource Consultants 2008b), the three prominent side channels in the lower river were surveyed. The focus of this survey was to: (1) determine the flow connectivity relationship between the mainstem and side channels; (2) estimate individual and cumulative wetted surface areas provided by mainstem flows; and (3) define habitat-flow relationships (based on PHABSIM analysis) within the channels for selected target fish species and life stages.

With regard to connectivity, the survey results indicate that the upstream ends of the three prominent side channels would become disconnected from the mainstem Sultan River at flows of less than 200 cfs for Side Channel 3, less than 300 cfs for Side Channel 2, and less than 375 cfs (approximately) for Side Channel 1 (Figure E.6.3-27). Under the proposed minimum instream flow schedule (Table E.6.2-7), Side Channels 2 and 1 have the potential to become disconnected from the mainstem. Side Channel 3 would remain connected to the mainstem year-round under the proposed flow regime.



Note: non-labeled side channels would be considered for enhancement if easements and/or permits cannot be obtained for side channels 1, 2, 3, A, and B

Figure E.6.3-27 Location of mapped side channel areas within OR-1 of the lower Sultan River.

Proposed PM&E

To increase the amount of aquatic habitat in the lower Sultan River, the District would enhance salmonid habitat function in a minimum of 10,000 linear feet of side channel area to provide a minimum of 3 acres of additional rearing habitat and other habitat functions. This habitat would be located within the wetted area of the Sultan River downstream of the Powerhouse defined by a flow of 4,100 cfs. This enhancement would be achieved through projects that improve flow connectivity or other habitat modification projects; however, it would also be subject to obtaining regulatory approval and legal access to any property necessary to carry out the above enhancement.

As part of this PM&E, the District would restore and maintain year-round flow connectivity between the mainstem Sultan River and the five prominent side channels located downstream of the Powerhouse (Side Channels 1, 2, 3, A, and B) (Figure E.6.3-27). At each of these side channels, the District would excavate the inlets or use other means to redirect and maintain flow to ensure that flow connectivity and habitat value is achieved at flows greater than 300 cfs. The District would design the excavation or other means utilized in these side channels so that connectivity is self-maintaining. The District would also design the side channel enhancements to avoid adverse impacts to surrounding properties (including the City of Sultan's recreational properties). If property easements or regulatory approval cannot be obtained, the District would develop, in consultation with the ARC, other similar projects in the Sultan or Skykomish river systems to meet the linear foot and square foot requirements dictated by this proposed PM&E.

The District would rely upon LiDAR, HEC-RAS modeling, existing studies and other available information to identify other side channels, swales, backwater and off channel habitats suitable for enhancement as salmonid rearing habitat within the Sultan River downstream of Culmback Dam. As described in the LWD PM&E, the District would use large woody debris collected at Culmback Dam to add structure and function to side channels.

Within 1 year of issuance of the License, the District would file with the Commission, for approval, a Side Channel Enhancement Plan (SCE Plan). This SCE Plan would document how the District would implement a program to enhance the salmonid rearing habitat function in a minimum of 10,000 linear feet of side channel area within the wetted geographic area defined by a flow of 4,100 cfs as measured at the USGS gaging station below the Powerhouse within the Sultan River downstream of Culmback Dam. The SCE Plan would include provisions that describe: (1) the method and schedule for restoring and maintaining year-round flow connectivity between the mainstem Sultan River and Side Channels 1, 2, 3, A, and B; (2) the method and schedule for excavating or using other means to redirect and maintain flow to Side Channels 1, 2, 3, A, and B; (3) the method and schedule for identifying, enhancing and maintaining other off channel habitat suitable for enhancement; (4) the use of large woody debris or other flow re-direction means to re-direct a portion of the mainstem flow into the side channels; (5) the use of large woody debris collected at Culmback Dam to add structure and function within the side channel; and (6) the method and schedule for monitoring (including reporting requirements) and maintaining side channel enhancements throughout the term of the License and any subsequent annual licenses.

The District would develop the SCE Plan in consultation with the ARC. The District would allow a minimum of 30 days for members of the ARC to comment and make recommendations before submitting the SCE Plan to the Commission. When filing the SCE Plan with the Commission, the District would include documentation of consultation, copies of comments and recommendations, and specific descriptions of how comments and recommendations from the ARC are accommodated by the District's plan. If the District does not adopt a recommendation, the filing would include the District's reasons based upon Project-specific information.

Upon Commission approval and obtaining any necessary regulatory approvals, the District would implement the SCE Plan.

Environmental Analysis

The existing side channels in the lower Sultan River provide important spawning and rearing habitats for numerous salmonids and other aquatic species. Enhancing and maintaining year-round connectivity to both these and additional relict side channels in the lower Sultan River would substantially increase the amount and quality of habitat available to anadromous and resident fish particularly during the summer low flow period.

Under existing conditions, OR-1 of the Sultan River contains a total of 3,910 feet of side channel habitat that remains connected to the mainstem at a flow of 300 cfs. Reconnecting and enhancing salmonid habitat function in a minimum total of 10,000 linear feet would increase the length of available side channel habitat in the lower river by roughly 150 percent. In addition, aquatic habitat in the side channels that are currently connected to the mainstem Sultan River and used by fish consists primarily of glides (54 percent) and low-gradient riffles (46 percent). Placing LWD and other structures in these side channels would create pools and cover for adult and juvenile salmonids. Strategically placed wood would also encourage the development of off channel wetlands which are used for juvenile rearing.

This increase in critical side channel habitat area should boost survival and production of anadromous populations in the basin. Species receiving the greatest benefit are expected to include coho, chum, pink and Chinook salmon, and cutthroat trout. It is believed that this proposed PM&E would provide immediate benefits to fish, but the exact gains would not be known until monitoring is conducted over a period of several years.

E.6.3.3.8 Monitor Salmon and Steelhead Escapement

Issue

Any new license for the Jackson Project would likely include a number of measures, such as modified instream flows, channel maintenance flows, and side channel and LWD enhancement that would change existing aquatic habitat conditions in the Sultan River. These altered habitat conditions could affect the distribution and abundance of salmon and steelhead, and may expand the distribution of some resident fish species. Fish population monitoring is often conducted to determine if environmental measures, such as those proposed by the District, are achieving the desired level of protection or enhancement. Fish population monitoring is typically focused on the presence or absence of particular species, numbers of particular species, or on community parameters (such as productivity, density, and diversity) and is usually conducted over multiple years.

Under existing license conditions, the District cooperates with the Joint Agencies to conduct annual salmon and steelhead trout spawning surveys in the Sultan River, downstream of RM 9.7. These surveys have been conducted since 1984.

Proposed PM&E

The District would continue to monitor steelhead trout and Chinook, pink, and chum salmon annual escapement in the Sultan River. Methods and procedures would remain unchanged in accordance with the protocols described in Section E.6.3.2.4.

Environmental Analysis

While numerous factors affect population abundance, Project operations have generally enhanced habitat conditions for fish populations as evidenced by the increasing trends in Chinook, pink, and chum salmon in the Sultan River under Stage II conditions. Monitoring annual escapement provides a means to ensure that Project operations are not negatively affecting the fisheries resource. Ongoing monitoring efforts would provide important data which the co-managers rely on to make informed management decisions.

E.6.3.3.9 Steelhead Planting Program

Issue

As part of the 1983 Settlement Agreement with the Joint Agencies, the District and City of Everett agreed to fund the annual planting of 30,000 fin-clipped steelhead smolts in the Snohomish basin. Both summer-run and winter-run steelhead are planted in June or July near the Powerhouse and at the mouth of the Sultan River.

Proposed PM&E

The District intends to continue supporting this program as long as it remains effective in providing a public angling opportunity. The District recognizes the need to remain flexible in the use of these funds as steelhead management strategies and recreational harvest goals evolve over time.

Environmental Analysis

Under existing conditions, the 30,000 adipose fin-clipped steelhead released into the Sultan River is a portion of the larger ongoing fishery enhancement effort in the Snohomish River system that includes the Pilchuck, Wallace, and the North Fork Skykomish rivers. However, the hatchery steelhead returns to the Sultan River contribute to a relatively small recreational fishery. Between 1995 and 2003, 650 steelhead were harvested in the Sultan River, with an average of 84 fish per year (Table E.6.3-10).

Table E.6.3-10 Annual sport harvest estimates for summer and winter steelhead in the Sultan River from 1995 through 2003.

Year	Annual Angler Harvest		
	Winter Run	Summer Run	Total
1995-1996	16	11	27
1996-1997	78	4	82
1997-1998	49	14	63
1998-1999	45	16	61
1999-2000	33	9	42
2000-2001	45	4	49
2001-2002	205	63	268
2002-2003	52	31	83
Average	65	19	84

Source: WDFW 2005

Impacts of all hatchery programs in the Puget Sound region, including the steelhead programs in the Snohomish River basin, are currently being analyzed by NMFS through the NEPA process. While there is a potential for genetic interaction with ESA listed natural-origin winter steelhead, genetic impacts on ESA listed steelhead are likely to be insignificant due to differences in spawning time (HSRG 2004). Interactions with naturally spawning summer steelhead are also minimized by releasing hatchery fish in the mainstem, well downstream of areas typically used by naturally spawning summer steelhead (HSRG 2004). The HSRG considered both summer and winter hatchery steelhead to have low population viability; therefore, if hatchery releases into the Sultan River were to cease, the potential for recreational harvest of the species would decline over the next few years until the last brood year returned to spawn.

E.6.3.3.10 Spada Lake Recreational Fishery Plan

Issue

Project operations result in Spada Lake water surface elevation fluctuations. These fluctuations can affect the seasonal quantity of aquatic habitat in the reservoir, the trout populations residing the lake, and the quality of the trout fishery. Lake level fluctuations are unavoidable under any operational scenario that incorporates meeting City water demand and minimum instream flow requirements.

Proposed PM&E

Under this proposed PM&E, the District would file with the Commission[31], a Spada Lake Recreational Fishery Plan (SLRF Plan). The SLRF Plan would document how the District would implement a program to enhance the Spada Lake recreational resources. Specifically, the SCE Plan would include the following provisions:

[31] Within one year of license issuance.

1. The District would remove existing man-made barriers to fish passage within tributaries along South Shore Road beyond South Shore Recreation Site (No. 3) subject to obtaining an agreement with DNR. The removal of these barriers would be done in conjunction with abandonment of portions of the South Shore Road beyond Recreation Site 3.

2. The District would improve the Recreation Site 2 boat launch by providing boat trailer access. This improvement would provide launch access to elevations as low as 1,410 feet msl. Throughout the license term, the District would maintain the boat launch (including repairing ramp structures down to elevation 1,410 feet msl) and on an annual basis (before the start of the recreation season) remove debris from the boat launch.

3. The District would improve grade and surface of boat launch at Site 3.

4. The District would prepare a recreational fishing brochure for Spada Lake that describes effective fishing techniques, including the best times and suggested locations. The District would make this brochure available on its web site.

Environmental Analysis

Removal of Man-made Migration Barriers

The District, subject to reaching an agreement with the Washington DNR, would remove existing man-made barriers to improve fish passage within the tributaries along the South Shore Road (beyond Recreation Site 3). While no field surveys were conducted to inventory the number and location of potential fish migration barriers within this area, the DNR on-line water type mapping database (http://fortress.wa.gov/dnr/app1/fpars/) indicates that the South Shore road crosses five fish-bearing streams, four streams mapped as non-fish-bearing, and four streams mapped as unknown fish-use. Based on map analysis and assuming impassable or partially impassable barriers are present at all stream crossings, removal of culverts would provide unobstructed access to approximately 4,000 feet of stream habitat (less than 15 percent gradient) mapped as fish bearing, including reaches of McCarty, Bear and Greider creeks, and two unnamed streams. Removal of culverts would also provide unobstructed access to 3,700 feet of stream habitat (less than 15 percent gradient) mapped as unknown fish-use (unnamed tributary system to McCarty Creek). This habitat could be accessed by cutthroat and rainbow trout from Spada Lake for spawning and rearing, although habitat quality and hydrologic regimes of these stream segments are currently unknown. Additional spawning and rearing habitat could increase trout production; however, forage quantity and quality in the lake would continue to be a trout population limiting factor (Meridian Environmental and Shuksan Fisheries Consulting 2008, Beauchamp 2008),

Improve Boat Launches and Provide Angling Brochure

Improving boat launches at sites 2 and 3 under this PM&E would provide anglers with continued access to the eastern and enhanced access to the southern portions of Spada Lake, the area with the highest densities of trout (Meridian Environmental and Shuksan Fisheries Consulting 2008). Improving access and providing a brochure to anglers detailing effective angling techniques may promote increased angler effort and harvest. Current 2009-2010 State angling regulations allow harvest of trout with no minimum size requirement up to a maximum of 12 inches in length. Trout over 12 inches cannot be retained, which was probably implemented by WDFW to protect the Spada Lake trout population broodstock. However, only about 1 percent of Spada Lake trout are over 12 inches in length (Meridian Environmental and Shuksan Fisheries Consulting 2008). Most of the mature trout population (i.e. broodstock) is between about 11 to 12 inches in length (Meridian Environmental and Shuksan Fisheries Consulting 2008).

Beauchamp (2008) recommended angling regulations (administered by WDFW) to preserve the largest and probably most productive trout spawners that are over 11 inches in length, and allowing harvest of smaller immature trout. Beauchamp (2008) hypothesized protecting most of the trout spawners (fish greater than 11 inches in length) and increasing harvest of smaller immature trout may lead to overall increased trout population productivity based on bioenergetics modeling. However, current regulations only protect a very small portion of the spawning population (i.e., fish over 12 inches). Promoting increased harvest would likely result in increased harvest of mature trout because current regulations make no special provision to protect the Spada Lake broodstock. Increased harvest of mature trout may result in reduced trout productivity and further degradation of the trout fishery in Spada Lake.

E.6.3.3.11 Adult and Juvenile Salmonid Migration Flow Releases

Issue

Salmon and steelhead run timing, migration success, spawning activity, emergence, and outmigration are all well adapted to the natural hydrology of the river they evolved in. While the effects of altering a river's hydrologic regime on salmon and steelhead migration success are seldom precisely known, it is likely that modification of the hydrologic environment has implications for native anadromous fish survival.

As described in Section E.6.2.2.1.1, operation of the Jackson Project has altered the natural hydrology of the lower Sultan River, decreasing the frequency, magnitude, and duration of peak flow events. While a reduction in peak flows has created a stable channel condition with little scour of redds, low and stable flows during the spring may affect juvenile salmonid migration rates and survival in the lower river (Kope and Botsford 1990; Cada et al. 1994; Healey 1991). A reduction in the frequency, magnitude, duration, of fall flows may also have implications for adult migration success (Sandercock 1991).

Proposed PM&E

Under this proposed PM&E the District would release the following juvenile outmigration flows and adult upstream migration flows from the Project Powerhouse. The objective of these flow releases is to enhance juvenile salmonid outmigration and adult salmonid upstream migration. The District would not be required to provide these flows in a year when the District determines that a drought event is probable or is occurring as described by the most current version of the City's Drought Response Plan.

Outmigration Flow Releases

If the daily average flow at USGS Gaging Station No. 12138160 is below 500 cfs for fourteen (14) consecutive days between April 15 and May 15 of any given year, the District would release a flow of between 800 cfs and 1,200 cfs from the Powerhouse for a duration of twelve (12) consecutive hours on 3 separate days in May. The District, in consultation with the ARC, on an annual basis, would determine the necessity, schedule, and magnitude (between 800 and 1,200 cfs) of the outmigration flow releases.

Upstream Migration Flow

If the ARC determines that a flow release is necessary to enhance adult salmonid upstream migration, the District would release a flow of 1,000 cfs from the Powerhouse for 24 hours at least one time during the first week of September.

Environmental Analysis

Although high magnitude flow events during the salmon and steelhead incubation period have been linked with reduced egg to fry survival (due to redd scour), short duration flow events of lesser magnitudes (pulsed flows) in the spring may serve to trigger juvenile salmonid outmigration and increase the survival of out-migrants (Cada et al. 1994; Healey 1991; Kope and Botsford 1990). Predation on migrating juvenile salmonids may also be lessened during spring high flow events for two reasons. First, predation efficiency is reduced at high river flows by higher turbidity, higher water velocities, and an increased tendency for prey to form aggregations. Second, faster downstream migration at high flows shortens the duration of exposure to predation risk (Berggren and Filardo 1993; as cited in Jager and Rose 2003).

In addition to benefiting juvenile outmigrants, short duration high flow events in the late summer and fall are also know to initiate the upstream migration of adult salmon, limit straying to other river basins, and facilitate swimming past natural and artificial barriers (Sandercock 1991).

Although there are limited data describing the benefits of pulsed flows in the Puget Sound region, implementing the Districts proposed juvenile outmigration and adult upstream migration flow releases would result in a more normative hydrograph in the lower Sultan River compared to existing conditions. This more normative hydrograph could serve to increase the survival of juvenile salmon and steelhead outmigrants during drought years and may also facilitate upstream migration of returning adults.

E.6.3.3.12 Reservoir Elevations

Issue

Project operations allocate water withdrawals from Spada Lake to meet the many competing needs of municipal water supply, electricity production, recreation, and ecological function. Balancing these needs over a water year requires the District to closely following an operational rule curve, while taking into account the Project's important incidental flood control capabilities to protect property and human safety in the lower Sultan River and Skykomish/Snohomish River floodplains.

Proposed PM&E

The District proposes operate the Project in a manner consistent with the Spada Lake Reservoir Rule Curves governing Project operation (Figure E.6.2-16). The purpose of the Spada Lake reservoir rule curves is to allow the District to provide a balance of reliable municipal water supply, instream flows, incidental winter flood storage, higher lake levels for early summer recreation and prevention or reduction of risk of spill following Chinook fall spawning and Steelhead spring spawning. The rule curves were developed based on the physical storage capacity of Spada Lake and the hydrology of the Sultan Basin. As discussed in Section E.6.2.3.2.8, the rule curves divide Spada Lake into five states that shift throughout the water year (July through June). This operational water year is used to minimize the change in storage from year to year.

Reservoir Fluctuations Analysis

Modeling of the Project's proposed rule curves and minimum flows indicate that the water level fluctuation patterns in Spada Lake are expected to be similar to existing conditions under relatively normal water years (Figure E.6.2-17). However, the draw down would be much lower than what occurs under existing conditions during a severe drought. Under the worst case modeled scenario (assuming no City of Everett water demand management), Spada Lake would be nearly 20 feet below elevation 1,380 feet msl in October and November (Figure E.6.2-17).

A large and prolonged reservoir drawdown during the fall (relative to existing conditions) could adversely affect the resident trout population in Spada Lake. Large drawdown events would decrease habitat area and increase competition in a lake that is already at or near its carrying capacity. Longer and lower draw downs may also reduce zooplankton production due to a shrinking of euphotic zone. In Spada Lake, the resident cutthroat trout and rainbow trout typically spawn in the winter and spring, and their ability to spawn in the lake's tributaries would not likely be affected by a large fall drawdown. There are a small number of non-native brook trout (a fall spawning species) residing in Spada Lake that could be affected by large and prolonged drawdown; however, the District is not aware of any barriers in the drawdown zone.

Based on the modeled water demand scenarios, proposed operations would slightly increase the spill frequency compared to existing conditions, but reduce the spill magnitude (spill duration would be about the same) during October (see Section E.6.2.3.2.8). Therefore, proposed Project operations should result in similar or less disruption (by reducing average spill magnitude) of Chinook salmon spawning than occurs under existing conditions (which is relatively rare).

Spill Frequency Analysis

The District has noted that in some years, inflow from higher than normal precipitation during August, September, or October can keep the elevation of Spada Lake abnormally high. These circumstances can increase the risk of spill in October (rather than in

November). Biologically, this is not preferable because spill in October may disrupt spawning Chinook salmon, a species that is listed as threatened under the ESA, or result in redd scour during the egg incubation period.

Under current conditions, the recurrence interval for spill events from October through April is approximately 2.7 years, or about 37 percent chance of spill each year. Modeled operations suggest the recurrence interval for spill events would be about 2.5 years, or a 40 percent chance of spill each year from October through April.

E.6.3.3.13 Modify the Maximum Flow Ceiling during the Chinook and Pink Salmon Spawning Period

Issue

Chinook and pink salmon redds produced at high flows may be dewatered during the incubation period if the spawning flow is significantly higher than the incubation flow. Increasing the current maximum flow ceiling from 400 cfs to 550 cfs would ensure continued successful incubation should flows drop to Project minimum stream flow requirements.

Proposed PM&E

To protect Chinook and pink salmon incubation, the District would increase the maximum flow ceiling in OR-1 from 400 cfs to 550 cfs during the September 15 to October 15 peak spawning period.. Based on previous habitat/flow studies conducted by the District, the stage associated with this ceiling would ensure that redds remain wetted should Project flows be reduced to the minimum of 300 cfs. Furthermore, the District would use spawner survey information to determine the highest relative channel elevation at which spawning has occurred during Chinook and steelhead spawning seasons. The District would attempt to keep redds covered with water until fry emergence has occurred. The spawning flow ceiling and corresponding minimum stream flow may be adjusted per consultation with the ARC.

Environmental Analysis

Under existing conditions, the District imposes a 400 cfs maximum flow ceiling during the Chinook and pink salmon spawning period in the lower Sultan River. This ceiling is believed to provide adequate redd protection if flows drop to the existing 200 cfs minimum flow during incubation. Similarly, the District believes that a commensurate 550 cfs ceiling during spawning should be adopted with the proposed increased minimum flow of 300 cfs during incubation. Under existing operations, flows exceed 550 cfs about 10 percent of the time below the Powerhouse in late September, and between 25 and 50 percent of the time in early October (Figure E.6.2-5). Therefore, to the extent possible, proposed operations to specifically limit flows to 550 cfs from September 15 to October 15 should further reduce the frequency of occurrence of these higher flows when compared to existing conditions.

E.6.3.3.14 Maintain River Temperature within Stage I Range

Issue

While maintaining pre-Stage II (1969-1980) water temperatures at the Diversion Dam has been an important objective of existing Project operations, the water temperature regime in the lower Sultan River is influenced by the seasonal stratification of Spada Lake and by the amount and depth of flow released from Culmback Dam. Water temperatures affect overall aquatic community productivity and can influence salmonid egg and alevin development, emergence timing, and juvenile and adult survival. Protecting Sultan River aquatic resources requires careful water temperature management.

Proposed PM&E

The District would continue to operate the Project in a manner designed to maintain water temperatures within the pre-Stage II range downstream of the Diversion Dam (see Section E.6.2.1.2). The operational goal of this measure is to ensure that Sultan River water temperatures closely mimic the pre-Stage II mean when Spada Lake is stratified (temperature control is only possible during reservoir thermal stratification, which typically occurs from April through October). The District proposes to operate the power tunnel water withdrawal structure at Spada Lake to approximate the daily mean of recorded pre-Project temperatures (within a band of 2°C to the extent possible). To ensure compliance with this measure, the District would continue to monitor water temperature at the Diversion Dam and Powerhouse on an hourly basis throughout each year. Annual reports would be prepared and submitted to the resource agencies, the Tribes and FERC.

Environmental Analysis

Under this proposed measure, Project effects on Sultan River water temperatures would be similar to existing conditions (see Section E.6.2.2.2). In general, temperatures are expected to remain only slightly warmer than Stage I conditions during the late-fall and winter due to the temperature of stored waters. Water temperatures are expected to be similar to Stage I conditions during the summer and early fall (Figure E.6.2-7).

The state standards for water temperature criteria were developed primarily to protect fish use designations. The Sultan River is designated as Core Summer Salmonid Habitat; key identifying characteristics of this designation are summer (June 15 – September 15) salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and sub-adult bull trout. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids (http://www.ecy.wa.gov/Programs/wq/swqs/desig_uses.html). The numerical water temperature criteria developed by Ecology and recently approved by EPA was developed to support these uses.

Available data indicate that Sultan River temperatures downstream of the Diversion Dam rarely exceed the 7-DADMax 16°C water temperature criteria for Core Summer

Salmonid Habitat (less than 0.2°C in 2007). For example, exceedences occurred only at the mouth of the Sultan River one day in 2007 (see Section 5.2.1.2.2). Therefore, it is assumed that the lower Sultan River water temperature regime is supportive of salmon and steelhead spawning, incubation, rearing, and migration. Seasonal water temperatures are within the tolerance range of all salmon and steelhead present within the Sultan River for all freshwater life stages. Further evidence that water temperature is conducive to successful fish production is the increasing trend for Chinook and pink salmon as described in Section E.6.3.2.1. Operational measures targeted at the compliance with the 7-DADMax 16°C criteria would result in either full compliance or in a greatly reduced frequency of criteria exceedence in OR-1, which currently is rare.

E.6.3.3.15 Water Temperature Conditioning in Operational Reach 3

Issue

Under existing Project operations, the District releases 20 cfs into the Sultan River at the base of Culmback Dam to maintain aquatic habitat in OR-3. Even though this release is relatively cold during summer (about 5 to 6°C), the water in OR-3 can warm at a faster rate than water released at the Diversion Dam and Powerhouse. This faster rate of warming during summer has resulted in occasional exceedences of the Core Summer Salmonid Habitat criterion of 16°C at the lower end of OR-3 (RM 9.8). During the 2-year water quality study, the 7-DAD Max reached 16.6ºC for a 5 day period in July 2007 at the site above the Diversion Dam. In addition, as discussed in Section E.6.3.3, the release of relatively cold water from Culmback Dam during summer also appears to be a factor in lower productivity of resident fish and macroinvertebrates inOR-3.

Proposed Measure

The District proposes to implement a program to condition the temperature of the water released at Culmback Dam in order to provide a seasonally appropriate water temperature regime that would improve conditions for aquatic resources (including resident fish and macroinvertebrates) in the bypass reach between Culmback Dam and the Diversion Dam (i.e., OR-3). In consultation with the ARC, the District would develop temperature conditioning performance standards for April through October in the bypass reach. The performance standards would be developed for points at the upstream end of the reach (where water is released) and the downstream end of the reach. These performance standards would be determined based on ranges of water temperatures that are suitable for aquatic resources (including resident fish and macroinvertebrates) as reported in the research literature.

The District would submit a Water Temperature Conditioning (WTC) Plan to FERC for approval within 180 days of issuance of the License. The WTC Plan would document how the District would implement a program to condition the temperature of waters released at Culmback Dam. The WTC Plan would include:

1) The preliminary operation plan for the conditioning of water released from Culmback Dam pursuant to the schedule for the Minimum Flow PM&E measure

(as described Section E.6.2.3.2) to achieve temperature conditioning performance standards in the bypass reach;

2) The method and schedule for, and limitations upon, temperature conditioning of water releases;

3) The method, the locations, and the schedule for monitoring water temperature within the bypass reach and the response of aquatic resources (including resident fish and macroinvertebrates) to water temperature conditioning;

4) The method and schedule for adjusting the water temperature release schedule based upon temperature monitoring; and

5) The temperature conditioning program annual reporting and ARC consultation requirements.

The District would develop the WTC Plan in consultation with the ARC. The District would allow a minimum of 30 days for members of the ARC to comment and make recommendations before submitting the WTC Plan to FERC. When filing the WTC Plan with FERC, the District would include documentation of consultation; copies of comments and recommendations; and specific descriptions of how comments and recommendations from the ARC are accommodated by the District's plan. If the District does not adopt a recommendation, the filing would include the District's reasons based upon Project-specific information. Upon FERC approval, the District would implement the WTC Plan.

The District would implement the temperature conditioning program within environmental limitations and the physical constraints of the Project's existing pipe infrastructure. The District would make temperature sensor and control valve modifications, as necessary, to implement this program. The water release points at Culmback Dam would be the 10-inch cone valve, the hydro unit, and the 16-inch auxiliary release line. Blending ratios associated with this temperature conditioning program would be determined by temperature monitoring of Spada Lake, at the Culmback Dam water release points, at the downstream end of the bypass reach, and/or possible other suitable locations in OR-3. The temperature conditioning program would be implemented only when: (1) reservoir elevations are greater than 1,410 feet msl; (2) the reservoir is stratified (typically May through October); and (3) conditions at designated monitoring points in the reach would otherwise not be within temperature conditioning performance standards.

The District would monitor water temperatures in the bypass reach between Culmback Dam and the Diversion Dam (OR-3) annually for the term of the License. The District would monitor water temperature on a daily basis for potential exceedence of state water quality criteria at the downstream end of the bypass reach. If monitoring indicates the potential for a possible exceedence (i.e., 7-DADMax greater than 16°C), the District would quantify the geographic extent of elevated temperatures and if warranted, incrementally increase the volume of cool water released from Culmback Dam. As discussed in Section E.6.3.3, the District also would monitor the biological response of aquatic resources (including resident fish and macroinvertebrates) to the temperature conditioning for the term of the License. The temperature conditioning monitoring would be done in consultation with the ARC.

Environmental Analysis

As discussed in Section E.6.2.3.3.2, the SSTEMP (Bartholow 2002) was used to evaluate the effects of the WTC plan on water temperatures in OR-3. Modeling results indicated water temperatures associated with the conditioned releases from Culmback Dam would increase compared to existing conditions. Predicted water temperatures were also used to calculate temperature units (TU), calculated as the sum of daily TU for the April-October period when trout growth occurs. One daily TU is equal to one degree above 5ºC[32] for a 24-hour period. In natural stream systems, TU is positively correlated with salmonid growth and production, which also is assumed to apply to fish growth and production in the bypass reach.

TU levels to support fish growth and production in the bypass reach would increase substantially in OR-3 from 62 to 955 TU below Culmback Dam and from 889 to 1179 TU above the Diversion Dam (as calculated from the mean temperature predictions summarized in Table E.6.2-11). For reference, the TU for Spada Lake inflow from April-October (above the influence of Project operations) is estimated at 800 TU (based on 2007-2008 data). Based on this analysis, temperature conditioning of minimum flow releases from Culmback Dam would result in a more normative water temperature regime and is expected to benefit aquatic resources in OR-3.

As discussed in Section E.6.2.3.3, 7-DAD Max water temperatures in excess of the 16°C criterion could occur during summer under unusually warm meteorological conditions. The District would monitor water temperature on a daily basis for potential exceedence of state water quality criteria. In the event of a potential exceedence, if warranted, the District would incrementally increase the volume of cool water released from Culmback Dam.

E.6.3.4 Cumulative Effects

Under existing conditions, the storage and diversion of water associated with the Jackson Project alters the natural hydrology, geomorphology, and water quality in the Sultan River downstream of Culmback Dam, which in turn affects the quality and quantity of aquatic habitat for resident and anadromous fish. In addition to these Project-related effects, non-Project related municipal water withdrawals, the City of Everett's Diversion Dam, agriculture, timber harvest, rural development, and commercial and recreational harvest have and will continue to affect aquatic habitat and fish community structure.

Implementation of the District's proposed minimum instream flows, process flows, side channel enhancements, and LWD enhancements would significantly improve aquatic habitat diversity in the lower Sultan River compared to existing conditions. These

[32] The TU calculations assume that seasonal growth of salmonids starts as temperatures exceed 5 ºC.

improved habitat conditions, in conjunction with ongoing Snohomish River basin-wide salmon and steelhead recovery efforts are anticipated to increase wild salmon and trout production in the Project vicinity. It is also expected that these measures would in turn slightly improve commercial and recreational fisheries.

While implementation of the District's proposed PM&E measures is expected to benefit aquatic resources in the long term, projected increases in the City of Everett's water demand (see Section 6.2.3.1.1) would cumulatively affect seasonal fish habitat availability. In general, and without taking into account additional water conservation measures implemented by the City, as the City's water demand increases beyond current levels (84 mgd), the remaining water budget for Spada Lake decreases, reducing the amount of water available for instream flows (as a result of increases in the frequency and duration of periods when Spada Lake arrives at its various flow conservation triggers). In OR-1, OR-2, and OR-3, average changes in habitat area values under the 144 and 192 mgd water demand scenarios (in combination with the District's proposed minimum flows) would be highly variable depending on species, life stage, and water year type (Tables E.6.3-11 through E.6.3-13 and Appendix C); however, they would generally remain within ± 15 percent of what would be available under the current 84 mgd water demand.

Table E.6.3-11 Percent increase in habitat area provided in OR-1 (compared to existing condition) under the proposed PM&E minimum flows for the three modeled City of Everett water demand scenarios.

Species	Life Stage	Average Habitat Area (ft^2)		
		Proposed PM&E (84 mgd)	Proposed PM&E (144 mgd)	Proposed PM&E (192 mgd)
Water Year - Wet				
Chinook	Spawning	1.9	5.6	7.0
Steelhead		0.0	0.0	0.1
Coho		0.0	0.2	1.1
Chum		0.0	0.6	2.1
Pink		5.4	5.3	0.7
Rainbow		0.0	0.0	0.1
Cutthroat		4.9	-8.5	-9.6
Chinook	Juvenile Rearing	0.2	-0.1	0.0
Steelhead		1.5	2.8	4.2
Coho		-1.5	-2.6	-4.2
Rainbow		1.0	1.8	2.3
Cutthroat		0.1	0.3	0.2
Water Year - Average				
Chinook	Spawning	14.5	10.2	5.2
Steelhead		0.0	0.0	-0.1
Coho		4.2	2.4	3.9
Chum		8.6	4.3	2.2
Pink		-6.8	-0.6	-6.9
Rainbow		0.6	0.5	0.4
Cutthroat		-11.3	-9.9	-8.6

Species	Life Stage	Average Habitat Area (ft²)		
		Proposed PM&E (84 mgd)	Proposed PM&E (144 mgd)	Proposed PM&E (192 mgd)
Chinook	Juvenile Rearing	0.1	0.1	0.2
Steelhead		4.9	4.4	4.0
Coho		-5.2	-3.8	-2.8
Rainbow		2.6	2.5	2.5
Cutthroat		14.5	10.2	5.2
Water Year - Dry				
Chinook	Spawning	2.5	-0.1	2.0
Steelhead		0.1	0.1	2.3
Coho		0.4	3.0	2.7
Chum		0.2	-0.1	-2.3
Pink		6.7	15.0	-0.4
Rainbow		1.6	2.6	3.5
Cutthroat		5.9	-6.7	-8.1
Chinook	Juvenile Rearing	-0.5	3.7	0.4
Steelhead		3.1	-0.4	4.1
Coho		-3.6	7.6	-2.1
Rainbow		1.4	2.1	2.7
Cutthroat		-0.3	0.3	1.2

Table E.6.3-12 Percent increase in habitat area provided in OR-2 (compared to existing condition) under the proposed PM&E minimum flows at the three modeled City of Everett water demand scenarios.

Species	Life Stage	Average Habitat Area (ft²)		
		Proposed PM&E (84 mgd)	Proposed PM&E (144 mgd)	Proposed PM&E (192 mgd)
Water Year - Wet				
Chinook	Spawning	8.1	8.1	9.1
Steelhead		-11.2	-11.2	-11.2
Coho		-0.6	-0.6	0.0
Chum		0.0	0.0	0.9
Pink		-9.5	-9.5	-9.5
Rainbow		0.0	0.0	-7.0
Cutthroat		4.9	-8.5	7.6
Chinook	Juvenile Rearing	-1.9	-1.9	-1.9
Steelhead		-4.6	-4.6	-4.5
Coho		2.0	2.0	2.0
Rainbow		1.0	1.8	-2.0
Cutthroat		0.1	0.3	-0.6
Water Year - Average				
Chinook	Spawning	9.4	12.3	3.2
Steelhead		-9.3	-9.3	-9.3
Coho		0.3	0.3	0.3
Chum		0.0	0.0	0.0
Pink		-9.2	-19.0	-20.6

Species	Life Stage	Average Habitat Area (ft²)		
		Proposed PM&E (84 mgd)	Proposed PM&E (144 mgd)	Proposed PM&E (192 mgd)
Rainbow		0.6	0.5	-6.9
Cutthroat		-11.3	-9.9	7.6
Chinook	Juvenile Rearing	-1.8	-1.8	-1.7
Steelhead		-5.1	-3.9	-3.2
Coho		2.0	1.0	0.3
Rainbow		2.6	2.5	-0.8
Cutthroat		0.1	0.5	-0.6
Water Year - Dry				
Chinook	Spawning	11.0	11.0	11.0
Steelhead		-8.0	-8.0	-8.0
Coho		-0.7	-0.7	-0.7
Chum		0.0	0.0	0.0
Pink		-9.1	-9.1	-9.1
Rainbow		1.6	2.6	-6.5
Cutthroat		5.9	-6.7	7.8
Chinook	Juvenile Rearing	-2.4	-2.4	-2.4
Steelhead		-5.7	-5.7	-5.7
Coho		3.5	3.5	3.5
Rainbow		1.4	2.1	-2.5
Cutthroat		-0.3	0.3	-0.9

Table E.6.3-13 Percent increase in habitat area provided in OR-3 (compared to existing condition) under the proposed PM&E minimum flows at the three modeled City of Everett water demand scenarios.

Species	Life Stage	Average Habitat Area (ft²)		
		Proposed PM&E (84 mgd)	Proposed PM&E (144 mgd)	Proposed PM&E (192 mgd)
Water Year - Wet				
Rainbow	Spawning	0	0.0	-12.4
Cutthroat		0	0.0	-10.0
Rainbow	Juvenile Rearing	0	2.1	1.4
Cutthroat		0	3.9	0.6
Water Year - Average				
Rainbow	Spawning	0	0.0	-7.8
Cutthroat		0	0.0	-7.2
Rainbow	Juvenile Rearing	0	11.6	2.2
Cutthroat		0	13.5	1.6
Water Year - Dry				
Rainbow	Spawning	0	0.0	-15.3
Cutthroat		0	0.0	-11.9
Rainbow	Juvenile Rearing	0	1.7	3.4
Cutthroat		0	3.3	3.8

The District's operations model also indicates that the level of Spada Lake would drop below elevation 1,380 feet msl (the depth of the bottom of the intake) on a more frequent basis as the City's water demand increases. As demand increases to 144 mgd in year 2035, Spada Lake would drop below elevation 1,380 feet msl in 28 of 109 modeled years. As demand increases to 192 mgd in 2060, it would drop below 1,380 feet msl in 53 of 109 model years. Although emergency water conservation measures implemented by the City would likely moderate these worst case scenarios, dropping below elevation 1,380 feet msl in the fall would reduce the Project's ability to mimic the pre-Project water temperature regime, resulting in cooler releases during the Chinook salmon spawning period. These 6 to 7°C cooler temperatures would likely affect Chinook salmon spawning success in the lower Sultan River and could significantly delay fry emergence. Although these temperature related impacts could be substantial, actively managing reservoir levels in consultation with the ARC, and making necessary adjustments in flow to protect aquatic resources would likely minimize these effects.

In addition to the above cumulative effects, the City of Everett's Diversion Dam[33], a structure that was present before the Jackson Hydroelectric Project and not required for its operation, would continue to block upstream fish passage at RM 9.7 of the Sultan River. This loss of historical habitat would continue to limit anadromous fish production in the Sultan River over the term of any new license. However, lost production (based on WUA spawning habitat availability at 100 cfs) would be relatively minor and is estimated at 35 adult steelhead and 150 adult Chinook annually (CH2M Hill 2008b).[34] It is also anticipated that the District's proposed flow, side channel and LWD enhancement measures in the lower Sultan River would more than compensate for this lost production.

Overall, the PM&E measures that would be included in a new license for the Jackson Project, combined with the recent recovery efforts being implemented in the Puget Sound region are expected to have an incremental beneficial cumulative effect on salmon and steelhead populations in the Snohomish River basin.

[33] The Diversion Dam is the only means that the City of Everett has to meet their water supply demand during temporary outages of normal Project operations or low reservoir conditions.
[34] Production potential estimates were not developed for coho salmon.

E.6.4 Wildlife and Botanical Resources

E.6.4.1 Affected Environment

The following sections describe the existing condition of terrestrial resources within the current Project area. The Project area for terrestrial resources (Figure E.6.4-1) encompasses lands and waters within the FERC boundary and lands the District and the City of Everett currently manage for wildlife under the Wildlife Habitat Management Plan (WHMP)[35]. The District owns four of the WHMP tracts shown in Figure E.6.4-1 (Lost Lake, Project Facility Lands, Spada Lake, Williamson Creek), plus additional acreage adjacent to Williamson Creek, while the City owns the Lake Chaplain Tract.

E.6.4.1.1 Vegetation

The Project area lies within the Western Hemlock Zone and Pacific Silver Fir Zone of the Northern Cascades Physiographic Province (Franklin and Dyrness 1973). The dominant native vegetation is similar in both zones and consists of dense forests of western hemlock, Douglas-fir and western red cedar (and Pacific silver fir at higher elevations). Scattered throughout the coniferous forests are individual and small stands of red alder, bigleaf maple and black cottonwood. These hardwoods are found primarily on wet and/or recently disturbed soils. The primary difference between the zones is elevation, which results in greater annual precipitation and more persistent snowpack in the higher Pacific Silver Fir Zone.

Most human development is limited to the lower portion of the Sultan River basin, below the Powerhouse. Most timber harvest in the basin occurred below Big Four Creek (RM 11.2, or approximately 1.5 miles above the Diversion Dam) in the 1920s (FERC 1981) and some stands have been harvested again more recently. Areas above Big Four Creek that have been harvested since the 1960s are in various successional stand conditions. Some old-growth forest[36] remains on steep slopes along the Sultan River between Culmback Dam and the Diversion Dam, and within the Jackson Project wildlife habitat management areas. The DNR's Morning Star Natural Resource Conservation Area (NRCA) on DNR lands in the upper basin also contains some old-growth forest.

[35] Lands shown in Figure E.6.4-1 as "Proposed TRMP Lands" include lands in the District's ownership that would be managed under a new Terrestrial Resource Management Plan (TRMP), attached as Appendix E and summarized in Section E.6.4.3.2.1.

[36] Although there are many definitions of old-growth forest in the Pacific Northwest, the term typically is used to describe stands that are at least 200 years old, support two or more species of trees, and have a deep, multi-storied canopy and an abundance of large-diameter live trees, snags, and coarse woody debris (CWD). In this document, the terms "late-successional" and "late-seral" forest are also used to describe older stands that include many, if not all, of the attributes of old-growth stands.

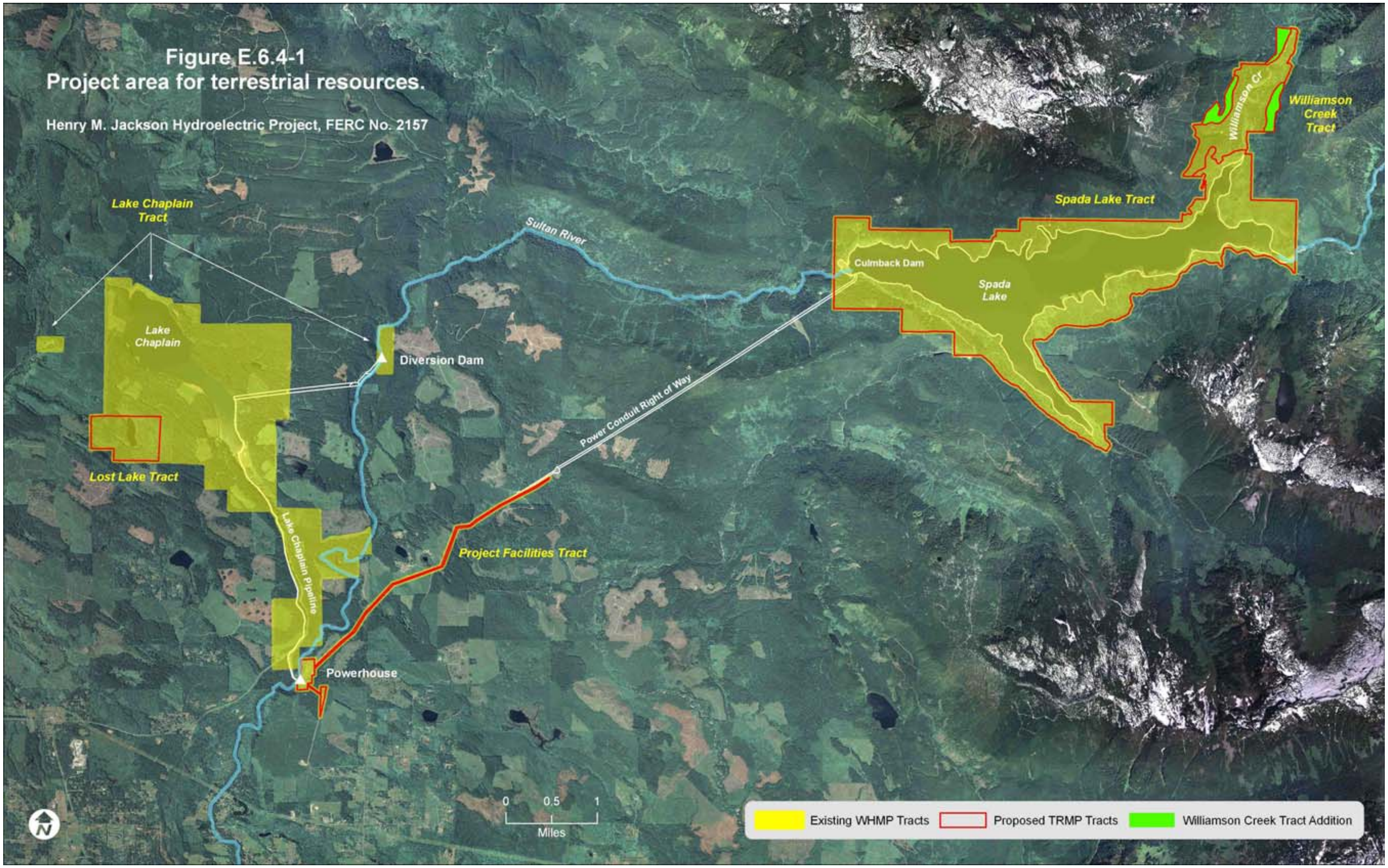


Figure E.6.4-1 **Project area for terrestrial resources.**

Vegetation cover types within the Project area include coniferous forest, mixed deciduous/coniferous forest, deciduous forest, riparian forest, mixed shrub/brush, grass/meadow, and wetlands (Table E.6.4-1). Cover type classifications were derived from the combined perspectives of forestry and wildlife habitat, and reflect characteristics that have developed naturally or as a result of wildlife habitat management activities. Detailed descriptions and maps of the cover types shown in Table E.6.4-1 are provided in the PAD (Snohomish County PUD and City of Everett 2005).

Table E.6.4-1 Cover types and acres within the existing WHMP tracts[1].

Cover Type	Acres
Early Successional Forest	241.1
Open-Canopy Sapling/Pole Coniferous Forest	92.8
Closed-Canopy Sapling/Pole Coniferous Forest	410.4
Small Sawtimber Coniferous Forest	1,947.8
Large Sawtimber Coniferous Forest	16.4
Old-growth Coniferous Forest	544.2
Mixed Deciduous/Coniferous Forest	730.0
Mosaic Deciduous/Coniferous Forest	169.1
Riparian Forest	68.0
Deciduous Forest	105.3
Grass/Meadow	57.4
Right-of-way (grass/meadow)	28.9
Mixed Shrub/Brush	42.7
Non-Vegetated	34.2
Wetland	109.6
Slides	2.9
Rock	12.1
Open Water	2,405.9
Total	7,018.8

[1] Acreages shown in Table E.6.4-1 have been updated since the PLP was filed in December, 2008, based on conversion to a new geographic information-based mapping system (GIS) and a boundary survey completed in May, 2009.

E.6.4.1.1.1 Plants of Importance to the Tulalip Tribes

In a letter dated March 15, 2005, the Tulalip Tribes provided a list of over 50 plants that are important for historical, cultural or spiritual reasons (Appendix H of the PAD) and requested additional information about their occurrence and distribution in the Project area.

To meet the intent of the Tribe's request, protocols for both the Rare Plant Survey and the Noxious Weed Inventory specified that surveyors should record a complete plant list for every surveyed site. In addition, surveyors documented large-diameter trees (diameters greater than 36 inches dbh) as present/absent for each survey site. These lists are attached to the Rare Plant Survey and Noxious Weed Inventory reports (Smayda Environmental Associates, Inc. et al. 2008a, 2008b).

E.6.4.1.1.2 Noxious Weeds

As many as 30 noxious weed species have been documented in Snohomish County (Rice undated). In 2007, the District conducted a noxious weed inventory in order to obtain site-specific information about species occurrence, distribution and abundance; evaluate potential Project effects on weed introduction and spread; and serve as the basis for development of a weed management plan (Smayda Environmental Associates, Inc. et al. 2008b).

The study area included all surface lands within the FERC boundary for the Jackson Project. Within the study area, weeds were also inventoried at sites where Project operations, or Project-related maintenance, land use practices, or human activities could promote the introduction, establishment, and/or spread of noxious weeds; on NFS lands within the riparian corridor between Culmback Dam and the Diversion Dam; and on selected District properties outside the FERC Project boundary.

The noxious weed inventory covered 1,089 acres. A total of 19 weed species and 520 infestations were recorded during the inventory, and incidentally during the rare plant survey that was also conducted in 2007 (Smayda Environmental Associates, Inc. et al. 2008a). Table E.6.4-2 lists the weed species that were documented and shows the number of infestations of each species, by geographic area. It also shows the 2007 County status of each species and defines various weed classifications in a footnote to the table.

The majority of weed infestations (313) are very small populations, consisting of one or a few individuals in an isolated patch. These populations generally cover less than 0.10 acre and often less than 0.01 acre, but some (74) larger areas (ranging in size from a few to over 30 acres) were also documented. Linear infestations (133), such as those occurring along roadsides, trails, and reservoir shorelines, vary in size from about 0.1 acre to several acres.

E.6.4.1.2 Wildlife

Because of its undeveloped nature, the Sultan River basin supports a variety of wildlife species typical of the Canadian and Hudsonian life zones in western Washington. Detailed species lists can be found in “Fish and Wildlife Resource Studies, Sultan River Project Stage II” (WDG and Eicher Associates, Inc. 1982). More recent sightings are presented in appendices to the marbled murrelet survey report (Biota Pacific 2008a).

Table E.6.4-2 Weed species, weed status, and number of infestations by geographic area.

Common Name/Scientific Name	2007 County Status*	Lake Chaplain and Diversion Dam	Lost Lake	Project Facilities, Pipeline ROW, and Trout Farm	Spada Lake, Rec Site 8, and Roads	Williamson Creek	NFS Lands in Sultan River Bypass Reach and FS Rd. 6122	Total
Spotted knapweed (*Centaurea biebersteinii*)	B designate	0	0	0	1	0	0	1
Yellow hawkweed (*Hieracium caespitosum*)	B designate	19	0	5	3	1	0	28
non-native hawkweed (*Hieracium sp.*)	B designate	1	0	0	1	0	0	2
Canada thistle (*Cirsium arvense*)	B, County selected	14	0	7	20	0	5	46
bull thistle (*Cirsium vulgare*)	B, County selected	26	0	12	25	4	1	68
invasive knotweed (*Polygonum sp.*)	B, County selected	1	0	0	0	0	0	1
tansy ragwort (*Senecio jacobaea*)	B, County selected	8	0	7	6	0	0	21
Scotch broom (*Cytisus scoparius*)	B	4	0	7	1	0	1	13
wild carrot (*Daucus carota*)	B	0	0	2	1	0	0	3
herb Robert (*Geranium robertianum*)	B	14	1	5	4	0	1	25
hairy cat's ear (*Hypochaeris radicata*)**	B	n/a	n/a	n/a	1	n/a	n/a	1
oxeye daisy (*Leucanthemum vulgare*)**	B	n/a	n/a	n/a	1	n/a	n/a	1
butterfly bush (*Buddleja davidii*)	C	12	0	3	0	0	0	15
common St. Johnswort (*Hypericum perforatum*)**	C	n/a	n/a	n/a	1	n/a	n/a	1

Common Name/Scientific Name	2007 County Status*	Lake Chaplain and Diversion Dam	Lost Lake	Project Facilities, Pipeline ROW, and Trout Farm	Spada Lake, Rec Site 8, and Roads	Williamson Creek	NFS Lands in Sultan River Bypass Reach and FS Rd. 6122	Total
Yellow archangel (*Lamiastrum galeobdolon*)	C	0	0	1	0	0	0	1
reed canarygrass (*Phalaris arundinacea*)	C	26	1	9	25	3	1	65
English holly (*Ilex aquifolium*)**	Not listed	n/a	n/a	n/a	0	n/a	1	1
Himalayan blackberry (*Rubus discolor*)	Not listed	42	1	17	27	2	2	91
evergreen blackberry (*Rubus laciniatus*)	Not listed	62	3	14	36	6	6	127
Total number of weed infestations per geographic area		229	6	89	153	16	27	520
Total number of target weed species per geographic area		12	4	12	15	5	11	
Total number of acres surveyed per geographic area		504	8	98	416	19	44	1089

* Class A species are those noxious weeds not native to the State that are of limited distribution or are unrecorded in the State. Eradication of all Class A species is required by State law. Class B species may be widespread in some regions of the State, and limited in distribution or unrecorded in other regions. In regions where a Class B species is of limited distribution or unrecorded, it is designated by the State (Class B-designate) for control. In regions where a Class B species is already widespread (Class B non-designate species), management is decided at the local weed board level (i.e., the species may be selected for management), with containment as the primary goal. Class C weeds may be widely established in Washington; control of these species is a local weed board option.
** Species of concern to USFS; presence recorded on NFS and immediately adjacent lands only.
Source: Smayda Environnemental Associates, Inc. et al. 2008a

Over 30 species of mammals are known to occur in the Project area. Table E.6.4-3 lists species that are most frequently observed. Black-tailed deer are the most common big game species in the Sultan basin, and are present year-round. Typically, black-tailed deer forage in meadows, shrub/brush, early successional stands and forest openings, and use older conifer stands for thermal cover. Riparian forests are important for fawning; where dense shrub cover is present, water is nearby and herbaceous forage is abundant.

Table E.6.4-3 Mammals (or their sign) most often observed in the Project area.

cottontail rabbit	pika	black bear
mountain beaver	mice	striped skunk
chipmunk	beaver	river otter
mountain lion	porcupine	bobcat
Douglas squirrel	coyote	black-tailed deer

Source: District Staff

Well over 100 bird species are found in the basin, including upland game birds, waterfowl, raptors and songbirds. Spada Lake, Lake Chaplain and Lost Lake provide resting habitat for spring, fall and winter migrant waterfowl, such as northern pintail, northern shoveler, green-winged teal, and American widgeon. Wood ducks, hooded mergansers and bufflehead are known to nest at Lost Lake and Chaplain Marsh (Snohomish County PUD 2005). Some of the species noted recently on Project lands are presented in Table E.6.4-4.

Table E.6.4-4 Example of birds recently observed in the Project area.

American dipper	bald eagle	rufous hummingbird
Virginia rail	osprey	purple finch
great blue heron	red-tailed hawk	song sparrow
belted kingfisher	Cooper’s hawk	Wilson’s warbler
mourning dove	raven	yellow warbler
ruffed grouse	turkey vulture	common yellow-throat
California quail	northern saw-whet owl	winter wren
pileated woodpecker	western screech owl	marsh wren
downy woodpecker	barred owl	red-winged blackbird
hairy woodpecker	great horned owl	cedar waxwing
brown creeper	pygmy owl	Swainson’s thrush
common loon	wood duck	blue-winged teal
common merganser	Barrow’s goldeneye	cinnamon teal
hooded merganser	common goldeneye	green-winged teal
eared grebe	harlequin duck	American widgeon
horned grebe	redhead	gadwall
pied-billed grebe	northern shoveler	mallard
western grebe	ring-necked duck	trumpeter swan
lesser scaup	greater scaup	Canada goose

Source: District Staff

As in other parts of western Washington, few reptiles are known to occur in the Project area. Observations of reptiles on Project lands include common garter snake, northwestern garter snake, and the northern alligator lizard (WDG and Eicher Associates Inc. 1982, Biota Pacific 2008a).

Pre-licensing studies in the early 1980s (WDG and Eicher Associates 1982) documented ten amphibian species in the Project area. These included the western toad, Pacific tree frog, red-legged frog, tailed frog, Cascades frog, Pacific giant salamander, northwestern salamander, western red-backed salamander, ensatina, and rough-skinned newt. Seven of these species were documented in 2007 and 2008 during surveys the District conducted to evaluate the potential effects of Project operation on amphibian habitat in wetlands, riparian areas, and the fluctuation zone of Spada Lake (DTA 2008). Five of these were "pond-breeding" species (northwestern salamander, rough-skinned newt, western toad, Pacific treefrog, northern red-legged frog) and two stream-associated species (coastal giant salamander and coastal tailed frog). Bullfrogs were also documented during the recent surveys. Additional information about the amphibian study is provided in Section E.6.4.2.2.2.

E.6.4.1.2.1 Wildlife Species of Interest to the Tulalip Tribes

In a letter dated March 15, 2005, the Tulalip Tribes provided a "species list of concern" (Appendix H of the PAD) and requested information about their occurrence and distribution in the Project area. The comprehensive list includes marine and other species that do not occur in the Project vicinity, but also identifies almost 300 animal species that may be present in the Sultan River basin. To respond to this request, biologists recorded sightings of all species observed during the marbled murrelet surveys. These observations are attached to the Marbled Murrelet Surveys Final Technical Report (Biota Pacific 2008a).

E.6.4.1.2.2 Wildlife Habitat Management Plan

Under current conditions, the existing WHMP guides management of five tracts of land totaling approximately 7,018.8 acres (4,672.6 acres of land and 2,346.2 acres of reservoir and lake) (Figure E.6.4-1). The District owns approximately 4,279.0 of these acres and the City (currently a co-licensee) owns approximately 2,708.1 acres. The remaining WHMP lands (power pipeline ROW in the Project Facility Lands tract) are secured through easements. Table E.6.4-5 summarizes the habitat characteristics and management priorities for each of the five management tracts.

Habitat enhancement methods for the mitigation lands are divided into six categories within the WHMP, as summarized below. Additional detail about these elements of the WHMP can be found in the PAD (Snohomish County PUD and the City of Everett 2005), as well as in annual reports that are available on the District's web site (http:www.snopud.com/WaterResources/relicensing.ashx?p=2334).

Table E.6.4-5 Existing WHMP management tract summary.

Tract / Size[1]	Ownership	Characteristics	Management Priorities
Lake Chaplain *2,704 acres*	City of Everett	Primarily second-growth conifer; includes mixed forest, wetlands, old-growth and riparian habitat	Protect water quality; improve wildlife habitat, manage for early seral species (deer) ; protect bald eagle nest site
Lost Lake *214 acres*	District	Includes 14-acre lake and high quality wetlands	Protect wetlands; enhance riparian and upland forest; improve waterfowl nesting habitat
Project Facility Lands *64 acres*	District	Located around facilities and ROW where habitat was disturbed in the past	Minimize disturbance; enhance meadow, shrub, open woodland habitat
Spada Lake *3,661 acres*	District	Spada Lake shoreline and 3 forest management units; primarily second growth conifer and mixed stands; also includes old-growth, wetland and riparian habitat	Manage forests to promote old-growth attributes in Old Growth and East Management Units; provide a mix of age classes in South Shore Management Unit
Williamson Creek *377 acres of land*	District	Old growth conifer forest, riparian habitat, and wetlands	Protect old-growth forest, riparian habitat and wetlands

[1] The acreage of each tract as described in the WHMP (2,657 acres in the Lake Chaplain Tract, 205 acres in the Lost Lake Tract, 79 acres in the Project Facilities Tract, and 344 acres in the Williamson Creek Tract) have been updated based on conversion to a new GIS and a boundary survey completed in May, 2009.

Forest Vegetation Management

The WHMP calls for the management of forest vegetation according to one of four silvicultural systems: 1) management of second-growth conifer forest on a 60-year even-aged harvest rotation, 2) retention of existing old-growth forest and adjoining second growth forest for late-successional habitat, 3) retention of some mixed forest and deciduous forest for mature mixed forest habitat, and 4) management of mixed forest at Lost Lake on a 60-year harvest rotation. Since initial implementation of the WHMP, management priorities have shifted. A number of stands at Lost Lake and all forest lands added at Spada Lake have been managed without even-aged harvesting, thereby increasing the total amount of forest being managed for late-successional habitat. Management for late-successional habitat benefits a wide range of species, including American marten, Douglas squirrel, northern flying squirrel, red tree vole, northern goshawk, brown creeper, cedar waxwing, and marbled murrelet, a federally listed species. Even-aged harvesting on a 60-year rotation comprises less than 27 percent of the terrestrial acreage managed under the WHMP and benefits black-tailed deer and other species of open habitats.

Snag Management

Snag management provides habitat for many species that use snags for nesting, roosting, hiding, foraging and food storage. The WHMP snag management program target is an average of 307 snags per 100 acres based on the needs of primary cavity nesting species (woodpeckers). They include hard and soft snags of varying widths and heights, with a minimum of 11 inches dbh and 10 feet in height. Inventory of existing snags, creation of additional snags, and long-term monitoring are part of the WHMP.

In addition to woodpeckers, many other species also benefit from snag management. These include American marten, bats, black-capped chickadee, common merganser, and western screech owl.

Coarse Woody Debris

Coarse Wood Debris (CWD) management is an integral part of maintaining a healthy forest ecosystem over time. CWD provides habitat for many species of animals, from large to very small. Managing CWD can also be important in helping wildlife species move safely through forested stands. The CWD management program calls for existing logs to be left undisturbed in harvest units when possible, and new material to be provided during harvest. In addition to logs found on site, an average of eight Douglas-fir or hemlock logs, with an average diameter of 20 inches and minimum length of 20 feet, are left per acre during harvest activities.

Wetland and Streamside Buffer Zones

Wetland and streamside buffer zones are implemented to protect the quality of wetlands and streams, and provide edge and travel corridors. Wetland buffers required by the WHMP and as included in the TRMP vary from 200 to 500 feet and stream buffers vary from 50 to 200 feet in width, as discussed in Section E.6.5.3.1. A large number of species likely benefit from these measures, including small mammals, black-tailed deer, bear, beaver, mink, great blue heron, American dipper, Virginia rail, yellow warbler, garter snake, and rough-skinned newt.

Right-of-Way Management

Right-of-way management includes pipeline Right-of-Ways (ROW) and a one-acre portion of the "Jackson Loop" transmission line ROW. Management of ROWs in the WHMP focuses on three main factors: 1) increased production of grasses, forbs and shrubs for forage; 2) placement of trees, shrubs and brush piles for cover and habitat diversity; and 3) limiting human use, particularly off-road vehicle use on the power pipeline ROW.

Nesting Habitat Enhancement

Nesting Habitat Enhancement measures identified in the WHMP consist of three types of nest structures, including waterfowl nest boxes, artificial nesting islands, and osprey nest structures. Waterfowl nest boxes provide nesting habitat for wood ducks, bufflehead and hooded mergansers. Artificial nesting islands offer waterfowl a predator-reduced environment. Osprey nest structures can increase production by providing a large, stable nest platform.

E.6.4.2 Project Effects

E.6.4.2.1 Vegetation

During FERC scoping, participants identified two key issues relating to vegetation. These are: 1) forest management activities that affect the amount of old-growth forest on Project lands, and 2) Project operations and Project-related activities that could promote the introduction or spread of invasive plants and noxious weeds. A third issue – potential Project effects on rare plants – is discussed in Section E.6.6 (Rare, Threatened and Endangered Species).

E.6.4.2.1.1 Forest Management Activities

Some participants in the scoping process raised the question of whether the forest management activities identified in the WHMP should be modified to place less emphasis on habitat for black-tailed deer, and more emphasis on habitat for species associated with old-growth forest. Scoping comments also requested that the District acquire additional old-growth habitat.

Old-growth forests are a key element of biodiversity of the Pacific Northwest. Their structural complexity provides habitat for many species of plants and animals that exist nowhere else, as well as high quality forage, nesting, and cover for wildlife species that make use of a broad range of forest types.

As shown in Table E.6.4-1, wildlife lands associated with the Jackson Project currently include 544 acres of old-growth forest. Most of the old-growth in the Project area is located within the Williamson Creek and Spada Lake tracts, with smaller amounts in the Lake Chaplain Tract. Old-growth stands as defined in the WHMP include live trees, snags and CWD greater than 24 inches in dbh, a multi-layered canopy with understory trees between 10 and 40 feet tall and highly variable canopy closure, ranging from 30 to 90 percent within a stand. The average age of dominant overstory trees is 200 years or older. Scattered deciduous trees, such as vine maple, black cottonwood and bigleaf maple are often present. Shrub layers are well developed and composed of both tall and low-growing species.

In addition to protecting about 544 acres of old-growth, the District currently manages about 1,630 acres of second-growth forest to promote the development of old-growth characteristics (Table E.6.4-6). Most second growth is cover-typed as small sawtimber. The small sawtimber condition is characterized by trees between 9 and 20 inches dbh and between 50 and 100 feet tall. Tree density is less than in younger stands due to mortality of suppressed trees; remaining trees are usually of cone-bearing age. Small sawtimber stands are usually between 40 and 80 years old. Canopy closure is generally uniform within the stand, ranging between 60 and 100 percent. Ground vegetation is dominated by moss and sword fern. Natural snags and CWD can be abundant in this stand condition because of suppression-related mortality, but they are generally of small diameter (less than 11 inches dbh).

Table E.6.4-6 Acres managed as part of the WHMP to protect existing old-growth forest and acres of second-growth forest managed to promote the development of old-growth characteristics.

WHMP Management Tract	Tract Ownership	Old-growth	Second-growth
Lake Chaplain Tract	City of Everett	42	239
Lost Lake Tract	District	0	0
Project Facility Tract	District	0	0
Spada Lake Tract	District	235	1,311
Williamson Creek Tract	District	267	81
Total		544	1,630

The amount of late-successional forest needed to mitigate for the impacts of original Project construction was determined through consultation with the resource management agencies and Tribes, based on the results of the impact Habitat Evaluation Procedure (HEP) conducted by the Washington Department of Game in 1982 (WDG 1982). The District's acquisition and protection of old-growth and late-successional forest under the existing WHMP exceed the HEP mitigation targets showing mitigation for over 200 percent and 110 percent, respectively, of the average annual habitat units (a function of habitat quantity and habitat quality) that were lost as a result of Project construction.

Continuing Project operations (the subject of this relicensing process) do not involve removing or altering any old-growth habitat. For this reason, the District is not proposing to acquire more old-growth or late-successional forest acreage. During the new license period, the District would continue to protect existing old-growth and manage younger stands to promote the development of old-growth characteristics. These younger stands are typically dense and uniform in structure, having a single tree canopy layer, a low shrub layer, sparse herbaceous groundcover, few snags, and little coarse woody debris. Such characteristics are the result of clear-cutting followed by intensive reforestation prior to their acquisition by the District. Without active management, these stands would eventually develop old-growth characteristics, but depending on site-specific conditions, they may not progress beyond the stem-exclusion stage[37] (Oliver and Larson 1990) during the new license period. Stands with high stem densities are subject to blowdown and stem breakage because tree diameters are relatively small in comparison to their height; the stress resulting from competition for water, light and nutrients makes these stands more susceptible to mortality from insects and disease. According to the literature reviewed as part of the Habitat Management Methods Literature Review and Evaluation Technical Report (Tannenbaum and Schutt 2007) and the District's observations on existing WHMP lands, the stem-exclusion stage is unproductive and undesirable for most wildlife species.

[37] The term "stem exclusion stage" reflects stand conditions that include loss of the understory as the tree canopy closes over and prevents light from reaching the forest floor, and the onset of mortality in the tree layer as a result of competition for growing space.

High stem densities impede the movement of large mammals, such as deer and black bear, and raptors, such as Cooper's hawk and great horned owl. High canopy closure limits the amount of forage for deer. It also reduces hiding and foraging opportunities for small mammals, which in turn reduces prey availability for forest raptors. The presence of a single tree canopy layer provides little vertical structural diversity, which in turn limits bird species diversity. Continued tree growth without active thinning activities would prolong the period during which these stands provide poor habitat for wildlife species that benefit from a range of seral conditions. For this reason, an alternative "hands-off" approach to managing these younger stands would not result in any increase in benefits to late-successional forest dependent wildlife within the new license period.

The City of Everett, with oversight by the District, currently manages about half (about 1,290 acres) of the Lake Chaplain Tract on a 60-year even-aged timber harvest rotation to promote habitat for black-tailed deer, as recommended by the resource management agencies during development of the WHMP in the late 1980s and through annual consultation since that time. The HEP conducted for the WHMP in 1988 (Snohomish County PUD 1988) indicated it would provide less than 100 percent mitigation for the young forest and mature riparian forest lost to original Project construction. For this reason, the WHMP employs periodic clear-cutting to replace foraging habitat for deer, rather than the creation of meadows and other open habitats that are difficult to maintain in the forest landscape of the Sultan Basin. This approach to management for deer requires the continuous creation of clear-cuts for open habitat. However, the benefits for deer are transitory as the harvested areas age, and many wildlife species, such as forest-dwelling birds, avoid clear-cut openings. Forest management practices in the WHMP address these negative habitat aspects of clear-cutting by including measures to schedule clear-cuts to maintain an interspersion of stand ages across the tract; limit the size of clear-cuts to 26 acres or less; leave green trees in each unit, revegetate clear-cut stands with palatable forbs and grasses; replant at a lower density than typical of commercial stands and as necessary, thin young forest stands to allow more growing space for trees and more light and moisture for shrubs and herbaceous groundcovers; create and maintain snags and coarse woody debris within stands to add structural diversity; and close and re-seed skid trails following harvest to prevent wildlife disturbance. While this type of management does not allow forest stands to reach late-seral conditions, it provides substantially better habitat than the typical industrial forestry approach to harvest, because it focuses on maintaining spatial and structural features that provide high quality habitat for a variety of wildlife species throughout the harvest rotation. As of December 2008, final harvest has occurred on 18 units, converting approximately 336 acres of dense small sawtimber to early successional or open canopy sapling/pole conifer forest. This represents less than 7 percent of the terrestrial lands managed under the WHMP.

In summary, the District's forest management activities are meeting the habitat objective for old-growth that was identified during development of the WHMP as being necessary to compensate for original Project impacts and operation through 2009. No new Project impacts on old-growth have been identified. The District is also managing habitat for black-tailed deer to meet WHMP objectives, but does not emphasize young seral stages to the exclusion of late-seral forest.

E.6.4.2.1.2 Plants of Importance to the Tulalip Tribes

As discussed above, the District's forest management activities include preserving old-growth conifer stands, promoting old-growth characteristics in adjacent younger stands, retaining mixed and deciduous forest, and managing second growth stands on an even-aged harvest rotation to support black-tailed deer. In planning stand management activities, the District aims to improve conditions to support native understory shrubs and forbs. The District establishes buffers around streams, lakes and wetlands to protect riparian and wetland plant communities. The District manages invasive plants and noxious weeds on Project lands and lands affected by Project operation to prevent the introduction or spread of species that would adversely affect native plant communities, and proposes to implement a Noxious Weed Management Plan to provide a more systematic, comprehensive approach to managing invasive species within the Project boundary.

While none of the current terrestrial resource measures are specifically intended to protect plants of concern to the Tribes, the combination of these measures sustains a diverse mix of the species identified on the Tribes' list.

E.6.4.2.1.3 Noxious Weeds

Noxious weeds and other invasive plant species can negatively affect native plant communities and wildlife, as well as recreation, aesthetics, cultural values, and economic resources. Several federal, state and county policies and regulations have been developed to address concerns about the spread of weeds, and to guide management of weeds on private and public lands. Executive Order 13112 directs federal agencies whose actions may affect the status of invasive species to manage these species. The U.S. Forest Service implements measures to prevent the introduction and control the spread of noxious weeds on NFS lands, in accordance with the Mt. Baker-Snoqualmie Land and Resource Management Plan (USFS 1990) and more recent decision notices on treatment of invasive plants for the Mount Baker-Snoqualmie National Forest (USFS 2005a and 2005b) and throughout Forest Service Region 6 (USFS 2005c).

In general, the District found that weeds in the inventory area occur within habitats that are disturbed by human activities: roadsides, human-maintained shrub and grass habitats at Project facilities, timber management units that have been commercially thinned and harvested, and recreation and river access sites (Smayda Environmental Associates, Inc. et al. 2008b). Moderate numbers of weed species and infestations were observed around Lake Chaplain, which fluctuates about 5 feet seasonally in response to the City's water supply requirements (not a hydro Project effect), and around Spada Lake, which fluctuates about 40 feet seasonally as a result of Project operations. Riparian habitats along the Sultan River bypass reach show relatively low numbers of weed species and infestations. Many of the weed infestations within timber units appear to have been introduced by equipment and vehicles used during the harvest activity, as evidenced by the close proximity of infestation of a given species on spur roads to established infestations on adjacent mainline roads (Smayda Environmental Associates, Inc. et al. 2008b).

No Class A weeds were documented during the 2007 weed inventory (Smayda Environmental Associates, Inc. et al. 2008b), and none had previously been observed in the Project area. Three Class B Designate species – spotted knapweed, yellow hawkweed, and unknown hawkweed – were reported. The surveys documented the presence of four Class B County-selected species: Canada thistle, bull thistle, tansy ragwort, and invasive knotweed. Surveyors documented the presence of five Class B undesignated species (Scotch broom, wild carrot, herb Robert and oxeye daisy), four Class C species (butterfly bush, common St. Johnswort, yellow archangel and reed canarygrass), and three species of concern to stakeholders (English holly, Himalayan blackberry, and evergreen blackberry).

Class B-designate species: Spotted knapweed was limited to a single, very small population that likely was introduced to the site by vehicles or road maintenance equipment. The plants were removed during the survey and the site will continue to be monitored by District staff to ensure that new seedlings do not become established.

Invasive hawkweed species were widely distributed across the Project area in association with disturbed, open habitats of roadsides, Project facilities, maintained shrub/grass habitats, reservoir margins, and recently harvested units. Hawkweed populations at the Project facilities and along Project roads are receiving ongoing management by the District to prevent their spread.

Class B County-selected species: Although frequently observed, neither Canada thistle nor bull thistle was present in large, dense infestations. Most of the sites supported relatively small numbers of plants.

Tansy ragwort was observed at a moderate number of sites, typically in infestations consisting of only one to a few plants, many of which were treated during the survey. The District manages tansy ragwort populations at Project facilities and along Project roads. One site, wetland 9-119 and the adjacent South Shore Road, has a well-established and potentially expanding population of tansy ragwort. Tansy ragwort at this site has been hand-pulled by District staff for several years and will continue to be managed.

Invasive knotweed is limited to a single site in the Project area, but it is abundant and spreading outside the Project area along the Sultan Basin Road in the vicinity of the 116th Street SE access to the Powerhouse site. It is also known to occur on DNR lands north of Lake Chaplain. Introduction of knotweed to the Project area could occur through transfer of seed and/or vegetative material, particularly by road maintenance and mowing equipment. District biologists and City Watershed Patrol are aware of this threat and actively watch for new occurrences of knotweed on or adjacent to Project lands.

Class B-undesignated, Class C, and species of concern to stakeholders: Four Class B undesignated species are present in the weed inventory area: Scotch broom, wild carrot, herb Robert, and oxeye daisy. Four Class C species are present: butterfly bush, common St. Johnswort, yellow archangel, and reed canarygrass. Three other species of concern to stakeholders— English holly, Himalayan blackberry, and evergreen blackberry—were recorded during the inventory. The District is currently managing Scotch broom, wild carrot, herb Robert, butterfly bush, and English holly at selected locations in the Project area. The District does not conduct Project-wide management of St. Johnswort, oxeye daisy, evergreen blackberry, Himalayan blackberry, or reed canarygrass, due to the widespread occurrence of these species throughout the County. However, the District does manage these species, and other non-natives, at individual sites where their presence prevents achievement of other Project resource objectives, such as establishment of deer forage.

E.6.4.2.2 Wildlife

Participants in the scoping process requested additional information about two federally listed species, the marbled murrelet and the northern spotted owl. Studies of these two species are discussed in Section E.6.6, Rare, Threatened and Endangered Species.

Participants in scoping also identified a need for additional information about amphibian occurrence on Project lands. In response to this concern, the District conducted surveys to evaluate potential Project effects on amphibians in Project-area wetlands, the fluctuation zone of Spada Lake, and along the Sultan River downstream of Culmback Dam (DTA 2008).

One commenter raised the question of whether the existing WHMP is adequate to achieve intended objectives and protect and enhance wildlife resources. The section below adds to the discussion presented in Section E.6.4.2.1.1, but focuses on the measurement of wildlife habitat values resulting from implementation of the WHMP.

E.6.4.2.2.1 Amphibians

Biologists found that one or more amphibian species are associated with most of the wetlands on the existing WHMP lands outside of the Spada Lake fluctuation zone (Section E.6.4.1.2). These wetlands are not affected by Project operations, and most are relatively remote. Sites that straddle roads used for recreational access could be subject to vehicle-mediated weed dispersal, and could be affected by weed management efforts.

Recreational activities such as fishing and nature-watching occur at Lost Lake and Chaplain Creek Marsh, but these activities are unlikely to adversely affect amphibians. Overall, the surveys indicated that wetlands on the existing WHMP lands were in good condition, with few signs of recreational use or disturbance that could affect amphibians.

Surveys revealed very few amphibian egg masses of just two species (northwestern salamander and northern red-legged frog) in the Spada Lake fluctuation zone (DTA 2008). Egg masses were found at only two sites, in numbers much smaller than observed at sites outside of the fluctuation zone. All of these egg masses were subsequently exposed by lower lake water levels; this was followed by a long period of higher water, during which time no amphibians were found using the lake. The results suggest that amphibian breeding in the Spada Lake fluctuation zone is uncommon. For this reason, continued operation of the reservoir is unlikely to represent a substantial loss of reproductive effort for amphibian populations.

Pond-breeding species did not occur in flowing water reaches within the Sultan River, but used adjacent pools, some of which are presumably recharged by the river during seasonal high flow periods. Bullfrogs were found at one site in the Sultan River riparian corridor (an old oxbow channel wetland in Osprey Park), which was also occupied by the other four pond-breeding species. The non-native, invasive bullfrog is known to prey on native amphibian species, and it would be desirable to eradicate this species; however, control is likely impossible due to the presence of bullfrogs in adjacent water bodies that would serve as sources for re-colonization.

Coastal tailed frogs (a federal species of concern) were found in most of the surveyed perennial streams flowing into Spada Lake, at one site (RM 14.4) in the Sultan River downstream of Culmback Dam, and in a tributary at RM 15.7 of the Sultan River. Occurrence of coastal tailed frogs in the Sultan River may be constrained by the patchy distribution of suitable habitats (i.e., clean cobble substrate). In particular, stream segments with long, deep pools may act as barriers to larval dispersal. Pools were characterized by sandy substrates unsuitable for larval feeding and without interstitial shelter from predators. Other areas with evidently suitable coarse substrates lacked preferred larval foods (a smooth sheen of diatoms over which larvae can graze) and were instead covered by foliose growths (other types of algae or moss) over which larvae cannot feed.

Occurrence of coastal tailed frogs may also be related to water temperatures in the Sultan River. In the upper bypass reach (OR-3), summertime water temperatures are generally about 6 °C. Based on a recent study of Pacific Northwest headwater streams (Welsh, Jr. and Hodgson 2008), optimal water temperatures for coastal tailed frogs are between 9.0 and 14.2 °C. Temperatures near the Diversion Dam may be more suitable for tailed frogs, ranging from about 8 to about 12 °C during most of the summer.

E.6.4.2.2.2 Wildlife Habitat Management Plan

The existing WHMP was developed in consultation with the resource management agencies and Tribes in the late 1980s to address the effects of Project construction and operation on wildlife habitat. To evaluate wildlife impacts, WDFW (then the Washington Department of Game) conducted a HEP in 1982 (WDG 1982). Ten evaluation species were selected to represent groups of animals, or guilds, which rely on or typically are found in the habitat types that were affected by Project construction. In the late 1980s, a companion HEP analysis was conducted concurrent with preparation of the WHMP (Snohomish County PUD 1988), to guide the development of management measures and estimate the resulting habitat benefits.

Table E.6.4-7 shows the estimated impact on each evaluation species through 2009 (Column A) and the benefits estimated to have accrued since implementation of the WHMP began in 1989 (Column B). The HEP calculations show that protection of habitat and implementation of forest management activities has resulted in substantial benefits for species associated with late-successional forest (pileated woodpecker, American marten, and Douglas squirrel); mitigation for original Project impacts through 2009 is almost complete for these species. Benefits to species that are associated with younger forests and forest openings (black-tailed deer, black-capped chickadee and ruffed grouse) are less, indicating that the WHMP's approach to habitat management is de-emphasizing these cover types or species in favor of late successional forest.

Table E.6.4-7 Impact and mitigation summary of habitat units under the existing WHMP.

	Column A	Column B	Column C
HEP Evaluation Species	Impacts through 2009*	WHMP Mitigation for 50 Years Only (1960-2009) All Tracts	WHMP Mitigation for 100 Years (1960-2060) All Tracts
Black-tailed deer	40,809	18,033	69,383
Black-capped chickadee	34,113	14,305	45,689
Ruffed grouse	26,831	11,336	54,501
Pileated woodpecker	26,833	25,150	84,816
American marten	24,628	22,783	67,287
Douglas squirrel	19,838	24,100	58,077
Mallard	-1,408	2,218	9,207
Common merganser	-15,939	934	7,007
Beaver	-2,349	1,578	7,278
Osprey	-31,985	7,331	44,481

Source: pers. comm., M. Vaughn, Biota Pacific, November 25, 2008.
* Negative number in Column A denotes net benefit.
Column A: That portion of Project impacts attributable to the period of 1960-2009. The original impact assessment included the effects of original Project construction through 2060. The effects of continued Project operation on terrestrial habitat are negligible.
Column B: Calculated mitigation benefits of original WHMP accrued to date (through 2009).
Column C: Projected mitigation benefits of the original WHMP if implemented through 2060.

The HEP calculations projected the impacts of original Project construction (i.e., habitat loss) to 2060, but in this relicensing, current Project operations are the baseline for environmental analysis. The major Project-related activity that now affects wildlife is implementation of the WHMP. As shown in Column C, continued implementation of the WHMP is anticipated to result in increasing benefits to all of the evaluation species over time.

The existing WHMP is based on ecological concepts that were advanced at the time it was developed. Some of the management activities have been modified over time, in response to changing conditions in the Project area and continuing consultation. The relicensing process offered an opportunity for the District to conduct a comprehensive review of the current body of wildlife habitat management literature, compare recent research with the practices currently applied as part of the WHMP, and identify management techniques that could be refined or improved for the WHMP (Tannenbaum and Schutt 2007). Most measures being implemented for the WHMP are consistent with current thinking and management methods. As part of this review, the District identified some changes in forest management that could potentially increase the benefits of management for wildlife species on a site-specific basis.

The benefits of each of these potential measures are discussed in detail in the Habitat Management Methods Literature Review and Evaluation (Tannenbaum and Schutt 2007). Appendix 4 of the literature review provides a summary of relevant potential alternative management techniques. It shows current WHMP forest management practices and management of wetland and riparian buffers, deer forage, nesting habitat, and rights-of-way and compares the methods with potential alternatives. The District has incorporated appropriate alternative measures into the TRMP (Appendix E) such as canopy gaps, variable density thinning, and decaying live trees.

E.6.4.2.2.3 Wildlife Species of Interest to the Tulalip Tribes

The existing WHMP includes a set of forest, riparian, and wetland habitat management practices that are intended to protect and improve habitat for a wide range of wildlife species that occur within the Project area. With a few exceptions (e.g., black-tailed deer, cavity-nesting ducks), the WHMP does not target individual species for management actions. Instead, it includes an array of measures that are intended to promote ecosystem health and biodiversity, which would in turn support those species that are of importance to the Tribes that occur in the Project area.

E.6.4.3 Proposed Environmental Measures

E.6.4.3.1 Vegetation

E.6.4.3.1.1 Forest Management Activities

The District is not proposing individual forest management PM&Es, but forest management is a key element of the TRMP that was developed to address wildlife habitat management. The TRMP is discussed further in Section E.6.4.3.2.2 and attached to this document as Appendix E. Briefly, as part of the TRMP, the District proposes to bring wildlife lands in its ownership (Lost Lake, Project Facility Lands, Spada Lake and Williamson Creek tracts, plus an additional 104 acres[38] adjacent to Williamson Creek that would be added to the Williamson Creek Tract) into the FERC boundary for the Jackson Project, and to manage them according to the TRMP. These areas, by cover type, are shown in Table E.6.4-8.

The TRMP is based on management and monitoring methods specified in the existing WHMP and supplemental plans and annual reports, stakeholder consultation, and the

[38] The District's original acquisition in the Williamson Creek Tract was estimated at 344 acres, and the 1991 acquisition was estimated at 137 acres, a total of 481 acres. A new boundary survey completed in May, 2009 shows that the original purchase was 377 acres, and the 1991 acquisition was 104 acres, also a total of 481 acres, as discussed in Section 6.7.3 and shown in exhibits D and G. The original estimates are retained in the TRMP (Appendix E) to be consistent with the habitat units calculated in the 1987-1988 HEP and the additional wildlife values expected to be gained through protection and management of 481 acres in the Williamson Creek Tract during the new license period.

results of the Habitat Management Methods Literature Review and Evaluation Final Report (Tannenbaum and Schutt 2007). With this measure, the District would protect all old-growth (a total of approximately 502 acres) within the four wildlife tracts. The TRMP would also provide for the management of 1,119 acres of second-growth conifer forest to promote the development of old-growth characteristics. Another 731 acres of mixed, deciduous and riparian forest would be managed in a similar way to promote old-growth or late-successional characteristics. This measure would increase the acreage of younger stands the District would manage to promote old-growth characteristics by about 220 acres over the amount that is currently managed under the WHMP to achieve these stand conditions.

Table E.6.4-8 Cover types and acres within the proposed TRMP tracts[1].

Cover Type	Acres
Early Successional Forest	18.0
Open-Canopy Sapling/Pole Coniferous Forest	25.0
Closed-Canopy Sapling/Pole Coniferous Forest	459.5
Small Sawtimber Coniferous Forest	605.6
Large Sawtimber Coniferous Forest	11.3
Old-growth Coniferous Forest	501.7
Mixed Deciduous/Coniferous Forest	455.1
Mosaic Deciduous/Coniferous Forest	169.0
Riparian Forest	56.9
Deciduous Forest	50.2
Grass/Meadow	20.3
Right-of-way (grass/meadow)	37.5
Mixed Shrub/Brush	21.8
Non-Vegetated	15.6
Wetland	39.7
Slides	2.9
Rock	12.2
Open Water	1,953.5
Total	**4,455.8**

[1] Acreages shown in Table E.6.4-8 are based on the WHMP acreages, but have been updated based on conversion to a new GIS and a boundary survey completed in May, 2009.

The TRMP would continue to provide mitigation for original Project impacts on forested habitat, as required by the current license. Some management methods currently included in the WHMP would be modified in the TRMP to improve the distribution of snags, decaying live trees, coarse woody debris, and canopy gaps; and revise thinning plans and schedules to ensure they are based on site-specific objectives and opportunities.

The only PM&Es proposed under the new license that are anticipated to affect forest vegetation are the construction of a new recreation site (described in Section E.6.7.3) located along the Culmback Dam Access Road and expansion of the turn-around area at the South Fork Recreation Site. The new site may require some tree and shrub removal on about 2 acres of closed canopy sapling/pole-sized conifer (less than 0.5 percent of this cover type), while improvements at the South Fork site may require clearing of less than 1 acre of mixed deciduous/coniferous forest (about 0.2 percent of this cover type).

E.6.4.3.1.2 Noxious Weeds

The following PM&E describes the District's proposal to implement a Noxious Weed Management Plan. The plan (provided in Appendix D) is based on the District's current weed control efforts, results of the noxious weed surveys (Smayda Environmental Associates, Inc. 2008b), and consultation with stakeholders during the ILP.

Issue

Landowners in the State of Washington are required by State law and various county ordinances to take steps to control the spread of certain specified noxious weeds on their property. The District, as a landowner, has been managing noxious weeds on Project lands in compliance with Washington State and Snohomish County requirements. In addition, the District voluntarily manages several other noxious weed species on Project lands. This PM&E will incorporate both ongoing and newly proposed management activities into the FERC license.

Proposed PM&E

The goal of the Noxious Weed Management Plan is to formalize and continue implementation of methods to control and contain the spread of Washington State Class A, Washington State Class B Designate and Snohomish County Selected noxious weeds within the Jackson Project boundary. The Plan also addresses the management of other selected weed species identified by the District and the adjacent land manager, U.S. Forest Service.

Environmental Analysis

Project-related activities, particularly those involving ground and habitat disturbance, have the potential to contribute to the occurrence and spread of noxious weeds. The District currently manages Washington State Class A, Washington State Class B Designate and Snohomish County Selected noxious weeds on Project lands in accordance with State and County laws and regulations. The District also manages other weed species to reduce their potential to spread. The District adopted an Integrated Pest Management approach to vegetation management in 1986; this approach emphasizes the use of manual and mechanical methods and limits the use of herbicides to protect water quality and other environmental resources. Surveys conducted in 2007 provided additional information on the number and distribution of noxious weed species on Project lands and National Forest System lands downstream of Culmback Dam. Formalization of ongoing weed management methods for the Project, incorporation of methods for new species and sites detected in 2007, and provision for regular update of weed lists are warranted to provide continued compliance with State and County requirements and to reduce the potential for Project-related contributions to the spread of these species.

The potential for new Project-related activities on non-Project lands to affect the occurrence and spread of noxious weeds will be evaluated on a case-by-case basis through the existing regulatory framework of the respective landowner or land manager.

The Noxious Weed Management Plan includes the following elements:

- A list of Washington State Class A, Washington State Class B Designate, Snohomish County Selected noxious weeds, and other noxious weed species identified for management at the Project (collectively referred to as target weed species), updated annually to reflect changes in State and County lists.
- A summary of target weed species occurring within the Project boundary based on ongoing weed management work and the 2007 Noxious Weed Inventory.
- A summary of ongoing weed management activities within the Project boundary.
- Treatment options and recommendations for established and new infestations of target weed species including management goals, measurable objectives, and priorities for treatment.
- Prevention strategies (e.g., best management practices for ground disturbing work, revegetation methods, and education information for Project employees).
- Monitoring and implementation schedules.
- Annual updates with Snohomish County Noxious Weed Control Board and U.S. Forest Service, including changes to the list of target weed species and a summary of weed management actions taken during previous year.
- A review of the plan every five years, in consultation with the Snohomish County Noxious Weed Control Board, U.S. Forest Service, and other stakeholders, addressing progress toward management objectives, modifications of treatment methods and population/species priority for treatment, and the list of target weed species.

Implementation of the Noxious Weed Management Plan would build on the District’s current approach to weed management, placing new emphasis on preventive measures, new sites identified in the 2007 inventory, training for District personnel, and weed prevention management practices for ground-disturbing activities. Implementing this plan would provide a comprehensive, systematic approach to weed management on Project lands and areas that may be affected by Project operation or Project-related activities. It would also help to protect native plant communities, including those that support plants and wildlife of cultural importance to the Tulalip Tribes.

The Noxious Weed Management Plan is designed to be responsive to changing conditions (e.g., changes in weed status, occurrence, or distribution). These provisions would help to ensure that the plan is effective throughout the new license period.

E.6.4.3.2 Wildlife

E.6.4.3.2.1 Amphibians

The results of the amphibian study did not indicate a need for any specific PM&Es. The District would continue to maintain and manage wetland and riparian buffers on Project lands through implementation of the TRMP, which would provide long-term protection for amphibian habitat. In addition, several PM&Es that are designed to improve conditions for anadromous fish would also affect amphibians. For example, the District's proposal to increase minimum flow releases (Section E.6.2.3.2.1); release process level flows below the Powerhouse (Section E.6.2.3.2.5); release whitewater boating flows (E.6.2.3.2.6); and release flows to benefit juvenile fish outmigration and adult fish upstream migration (Section E.6.2.3.2.7) may provide additional habitat for amphibians in off-channel pools along the Sultan River.

Reconnection of side channel habitat along the lower Sultan River (Section E.6.3.3.7) could increase or decrease the amount of wetland habitat available for some amphibian species. The District proposes to develop and implement a plan to provide a minimum of 10,000 linear feet equivalent to 3 surface acres of salmonid rearing habitat at side channel sites primarily by excavating and contouring side channel entrances and exits and using LWD structures to divert water into the side channel. The quantity and quality of habitat resulting from implementation of this measure would depend on specific treatments that would be developed as part of the proposed Side Channel Habitat Enhancement Plan.

Under current conditions, summertime water temperatures in the Sultan River may vary considerably from the upper end to the lower end of the bypass reach (OR-3), with temperatures near Culmback Dam generally about 6 °C during the summer and water temperatures near the Diversion Dam occasionally exceeding 16.6 °C. To increase water temperatures near Culmback Dam and reduce temperatures near the Diversion Dam during the summer, the District would develop a Water Temperature Conditioning Plan. The plan would include monitoring daily temperatures for potential exceedences of water quality criteria. If monitoring indicates the potential for a possible exceedence of the state criteria at the Diversion Dam, the District would quantify the geographic extent of elevated temperatures and if warranted, incrementally increase the volume of cool water released from Culmback Dam (Section E.6.2.3.3.2). This approach is anticipated to provide warmer water temperatures near Culmback Dam and cooler water temperatures near the Diversion Dam. Because optimal temperatures for coastal tailed frogs are thought to be in the range of 9.0 to 14.2 °C (Welsh, Jr. and Hodgson 2008), this proposed PM&E could result in a small benefit to this species, as well as to salmonids and macroinvertebrates within OR-3.

E.6.4.3.2.2 Terrestrial Resource Management Plan

The following PM&E describes the District's proposal to implement a Terrestrial Resource Management Plan (TRMP). The plan (presented in Appendix E) is based on the existing WHMP and supplemental plans and annual reports, consultation with stakeholders during the ILP, and the results of the Habitat Management Methods Literature Review and Evaluation Final Report (Tannenbaum and Schutt 2007).

Issue

The current license for the Jackson Project requires the District to mitigate for impacts of original Project construction and operation through 2010. Since implementation of the WHMP did not begin 1989, until almost 30 years after initial Project construction, the HEP conducted in 1987-1988 showed that management and enhancement would be required after 2010 to fully compensate for the impacts of the current license. The HEP also quantified impacts for a second 50-year license term, but that quantification was based on the assumption that original Project impacts would continue past the first license term. Since the baseline condition for assessment of impacts during the second license term is the constructed Project, impacts addressed in the 1987-1988 HEP for the period after 2010 are not part of the relicense assessment.

In addition to the residual mitigation for the current license, an assessment of Project operations and proposed PM&Es that would be implemented during the new license period indicate that mitigation should also address minor effects on wildlife that could result from development of a new recreation site, improvement of existing recreation sites, implementation of a whitewater boating program, implementation of side channel enhancements (discussed above in Section E.6.4.3.2.1), and reservoir fluctuations around Spada Lake (discussed in Section E.6.5.3.1).

Proposed PM&E

The District proposes to bring wildlife lands in its ownership (Lost Lake, Project Facility Lands, Spada Lake and Williamson Creek tracts, plus an additional 139 acres adjacent to Williamson Creek that would be added to the Williamson Creek tract) into the FERC boundary for the Jackson Project. These tracts are collectively referred to as the "TRMP Lands" and are shown in Figure E.6.4-1. The District will manage the TRMP Lands in accordance with the objectives established under the WHMP, except for updates to reflect current regional priorities for habitat management. Thus, the TRMP continues the WHMP, with the following modifications:

- The Spada Lake Tract Supplemental Plan dated January 31, 2007, and approved by the FERC on August 21, 2007, will be incorporated into the TRMP. The Supplemental Plan addresses the addition of 1,745 acres of forestland above elevation 1,460 feet along Spada Lake that were not included in the HEP analysis of WHMP habitat benefits.
- The Williamson Creek Tract will be increased by 104 acres to reflect the addition of three parcels in Sections 12 and 13 of Township 29 North, Range 9 East. These lands were acquired by the District from the Washington Department of Natural Resources

in 1991. They will be managed to provide wetland and late-seral conifer forest habitat. These parcels were not included in the WHMP or associated HEP analysis of habitat benefits.

- All modifications to the WHMP and Supplemental Plan made through the adaptive management process and documented in annual reports prepared by the District between 1989 and 2007 will be incorporated into the TRMP, except those associated with the Lake Chaplain Tract.
- Even-aged timber harvesting in the Lost Lake Tract and Spada Lake Tract will occur only with prior site-specific approval of the USFWS and WDFW. Single tree removal, variable density thinning, and patch clearings of up to 1.0 acre may occur without site-specific review and approval where determined necessary by the District to maintain or enhance late-seral conifer forest habitat conditions.
- Artificial nesting islands are not included in the TRMP, because they have proven ineffective at increasing nesting of target waterfowl species.
- Osprey nest structures are not included in the TRMP, because they have not received use in recent years.
- Forest management prescriptions have been updated to improve the distribution of snags, decaying live trees, coarse woody debris, and canopy gaps; and revise thinning plans and schedules to ensure they are based on site-specific objectives and opportunities.
- The Lake Chaplain Tract will not be included in the TRMP because it is no longer needed for Project purposes.

Environmental Analysis

The impacts of original Project construction and operation on fish and wildlife were estimated in studies conducted by the Washington Department of Game (currently WDFW) between 1979 and 1982 (WDG 1982). Wildlife impacts were assessed by collecting cursory population data and performing a habitat assessment using a HEP. At the direction of the FERC, the District and the City prepared a WHMP to mitigate impacts to wildlife from Project construction and operation. The WHMP was designed to mitigate for these impacts for 100 years (through 2060). The WHMP was prepared in cooperation with the USFWS, WDFW, Tribes and U. S. Forest Service, Mt. Baker – Snoqualmie National Forest (USFS), and was approved by the FERC in 1989. The District has managed most of the lands covered by this TRMP under the WHMP since 1989. The WHMP also covered the management of 2,704 acres of forest, wetland and lake owned by the City and known as the Lake Chaplain Tract.

District and City lands have been managed under the WHMP to provide early-successional forest, old-growth forest, riparian forest and wetlands. Habitat for early-successional species such as the black-tailed deer, black-capped chickadee and ruffed grouse has been provided primarily in the Lake Chaplain Tract, concurrent with commercial timber production by the City. Habitat for late-successional and old-growth species such as the pileated woodpecker, Douglas squirrel and marten, as well as riparian habitat for species such as black-tailed deer and ruffed grouse, has been provided primarily on District lands. Wetland habitat has been provided on both District and City lands.

Since 1989, the District has acquired additional early-successional, old-growth and wetland habitat, and the regional priorities for wildlife mitigation have shifted away from early-successional habitat and toward old-growth. As a result, the Lake Chaplain Tract is no longer essential to Project mitigation. The District now has sufficient lands without the Lake Chaplain Tract to mitigate for Project impacts to high priority habitats such as old-growth forest and wetland. Consequently, the Lake Chaplain Tract is not included in the TRMP. The City will continue its commitment to management of this tract according to the WHMP.

The TRMP would fulfill the District's obligations to mitigate for impacts to wildlife habitat resulting from the construction and operation of the Project through 2010, and for continued operation of the Project after 2010. Management would focus on preserving old-growth habitat and implementing measures that would promote the development of old-growth characteristics in younger stands, as well as continued protection of wetland and riparian buffers.

The habitat benefits of the TRMP were determined by removing the Lake Chaplain Tract from the original HEP from 2010-2060 (Table E.6.4-9). Habitat units associated with the TRMP were calculated by multiplying the original HEP habitat suitability index (HSI) values for each evaluation species and each habitat type by the acreages of habitat types that would be provided under the TRMP. For comparison purposes, the results of the original impact HEP (Column A) and the original WHMP (Column B) are also shown in Table E.6.4-9.

These calculations show that mitigation provided under the existing WHMP through 2009 (Column B) comes very close to meeting mitigation targets (Column A) for species evaluated as indicators for late-seral forest (pileated woodpecker, American marten, and Douglas squirrel). By 2060, without inclusion of the Lake Chaplain Tract after 2009[39], the additional mitigation provided by the TRMP (Column D) will have resulted in total mitigation (Column E) that exceeds the target amounts for late-seral forest species, even without inclusion of the Lake Chaplain Tract after 2009.

By contrast, mitigation provided under the WHMP through 2009 is less than the mitigation targets for species that are indicators of young forest and forest openings (black-tailed deer, black-capped chickadee, and ruffed grouse). Young forest and shrub habitat provided by the TRMP after 2009 would make up some of the mitigation deficit, but total mitigation by 2060 would still fall short of targets for these three species, primarily due to the emphasis on management for late-seral forest habitat under the WHMP and the TRMP.

[39] Calculations shown in Table E.6.4-9 are based on the year the calculations were made (2009), although the Lake Chaplain Tract would not be removed from the WHMP until a new license is issued.

Table E.6.4-9 Impact and mitigation summary of habitat units, with and without Lake Chaplain Tract.

	Habitat Units**					
	Column A	Column B	Column C	Column D	Column E	Column F
HEP Evaluation Species	Impacts through 2009*	WHMP Mitigation for 50 Years Only (1960-2009) All Tracts	WHMP Mitigation for 100 Years (1960-2060) All Tracts	TRMP Mitigation 2010-2060 without Lake Chaplain	Total Mitigation 1960-2060 without Lake Chaplain after 2009	Net Mitigation Deficit without Lake Chaplain after 2010*
Black-tailed deer	40,809	18,033	69,383	17,188	35,221	5,588
Black-capped chickadee	34,113	14,305	45,689	11,548	25,853	8,260
Ruffed grouse	26,831	11,336	54,501	14,939	26,275	555
Pileated woodpecker	26,833	25,150	84,815	18,629	43,779	-16,947
American marten	24,628	22,783	67,287	13,890	36,672	-12,044
Douglas squirrel	19,838	24,100	58,077	6,662	30,762	-10,924
Mallard	-1,408	2,218	9,207	5,788	8,006	-9,414
Common merganser	-15,939	934	7,007	925	1,860	-17,799
Beaver	-2,349	1,578	7,278	3,302	4,879	-7,227
Osprey	-31,985	7,331	44,481	20,105	27,435	-59,420

Source: pers. comm., M. Vaughn, Biota Pacific, November 25, 2008.
* Negative numbers in Column A and F denotes net benefit
** Calculations shown do not include 104 acres adjacent to the Williamson Creek Tract and 1,745 acres in the Spada Lake Tract that were not evaluated in the original HEP, because they had not yet been acquired in 1988. The addition of these acreages, plus implementation of management measures on these acres, would increase the number of habitat units for species associated with early successional stands as well as those associated with older forest.
Column A: That portion of Project impacts attributable to the period of 1960-2009. The original impact assessment included the effects of original Project construction through 2060. The effects of continued Project operation on terrestrial habitat are negligible.
Column B: Calculated mitigation benefits of original WHMP accrued to date (through 2009).
Column C: Projected mitigation benefits of the original WHMP if implemented through 2060.
Column D: Project mitigation benefits from 2010 through 2060, if Lake Chaplain Tract is not included in the HEP calculations.
Column E: Total Project mitigation benefits (1960 through 2060) if Lake Chaplain Tract is not included in the HEP calculations after 2010.
Column F: Amount of mitigation needed to compensate for impacts through 2009, if Lake Chaplain Tract is not included.

It is important to note that the TRMP lands contain sufficient acreage (Table E.6.4-8) to meet the mitigation targets for young forest and non-forest habitats used by the black-tailed deer, black-capped chickadee and ruffed grouse, but management for these habitats are de-emphasized in the TRMP in favor of late-seral forest habitat on the TRMP lands to meet the stated objectives of the wildlife agencies and other stakeholders.

It is also important to note that the calculations shown in Table E.6.4-9 do not include 104 acres adjacent to the Williamson Creek Tract and 1,745 acres in the Spada Lake Tract that were not evaluated in the original HEP, because they had not yet been acquired in 1988. The addition of these acreages, plus implementation of management measures on these acres, would increase the number of habitat units for species associated with early successional stands as well as those associated with older forest.

As mentioned above, Project operations and implementation of several PM&Es may have minor effects on wildlife. These include reservoir fluctuations, side channel improvements, construction of a new recreation site, enhancement of existing recreation sites, and implementation of a whitewater boating program. Construction of a new flow discharge structure near the City's Diversion Dam may also affect wildlife.

Revised Reservoir Rule Curves

As discussed in Section E.6.2.3.8.2 and shown in Figure E.6.2-12, the proposed rule curves for Spada Lake would be similar to existing conditions during high and average water years. During low water years, the proposed curve would reduce reservoir elevations more rapidly in late summer than under current conditions. This change could affect lake fringe wetlands, by exposing them to drought stress more rapidly, earlier in the summer, and for a longer period of the growing season than under current conditions. Reed canarygrass is tolerant of a variety of moisture regimes, and for this reason, is likely to persist under new conditions, while the cover of native species growing in these fringe wetlands may be reduced. Reed canarygrass is not considered to provide high quality habitat for wildlife, so an increase in the area it occupies could affect wildlife species such as red-winged blackbirds and marsh wrens that rely on native wetland plants. However, such changes are expected to be small, given the limited area of lake fringe wetlands even under current conditions.

Side Channel Enhancement Plan

The District proposes to excavate entrances at side channels along the lower Sultan River to improve rearing conditions for salmon in a minimum of 10,000 linear feet equating to 3 surface acres. The effects of this measure on wildlife would depend on specific site designs, and would be likely to vary from species to species. For example, improvements for fish would also be likely to slightly increase the prey base for picivorous birds and mammals, while conversion of wetlands to open water would reduce habitat availability for species such as yellow warbler and beaver.

Recreation PM&Es

The District proposes to construct a new recreation site near the intersection of the Culmback Dam Road and Forest Road (FR) 6122 (Figure E.6.7-1). The site would accommodate parking for six vehicles, two to four picnic sites, bear-proof trash receptacles and interpretive signs. Some trees and shrubs would be removed on approximately 2 acres of closed canopy sapling/pole-sized conifer forest in order to develop the site.

At the South Fork Recreation Site, the District would improve the existing boat ramp to accommodate trailered boat access and expand the turn-around area. This measure would require the removal of less than 1 acre of mixed deciduous/coniferous forest. This site is expected to become the primary boat launch site on Spada Lake.

The DNR is proposing to abandon the South Shore Road at the South Shore Recreation Site, and to develop a trail that would provide pedestrian access to the Nighthawk and Bear Creek recreation sites, and eastward to the Greider and Boulder Lake trailheads.

As a result, vehicles could no longer be driven to the Nighthawk or Bear Creek Recreation sites. The District proposes to replace existing toilets at both sites with a different type of sanitation facility, remove the concrete boat ramp at Nighthawk, and install new guardrails at Bear Creek. Disturbed areas would be revegetated with native tree and shrub species and grasses suitable to the site. The District would monitor use and maintain these sites through the new license period.

The District proposes to restore hiking and biking recreation access to the North Shore Recreation Site by improving access across Culmback Dam. The District would upgrade signage and railings at the North Shore site, and continue to monitor and maintain the picnic areas and vault toilets.

The District proposes to abandon the District owned 0.5-mile portion of the 6122 Road that crosses wildlife lands near Culmback Dam, and convert the District owned Forest Road 6122 to a non-motorized trail. The District would also install a lockable gate that would allow authorized vehicle entry only. The new trail would be designed to allow ORV access as requested by miners.

To provide access to whitewater boaters, the District would construct a trail following the existing auxiliary release flow line down the face of Culmback Dam to the canyon entrance.

At the Trout Farm Road River Access Site, the District would better define the existing parking spaces, remove noxious weeds, revegetate degraded areas with native trees, shrubs and grasses, and remove boulders that interfere with boat launching. The District would also improve informational signage and increase management presence to deter vandalism and dumping that have occurred in the past.

The effect of each of these PM&Es on wildlife is expected to include temporary and localized disturbance during construction. With the exception of the new recreation site and possibly the trail from the face of Culmback Dam into the canyon, no habitat would be removed or altered.

Over the long term, the potential for wildlife disturbance would be expected to increase slightly at the upper end of the canyon as a result of improved access and implementation of a whitewater boating program. Disturbance would also be expected to increase slightly at the North Shore site, but would be limited to hikers and bicyclists.

Construction of a new recreation site and improvements at the South Fork site would likely draw more visitors than under current conditions, and the potential for disturbance, harassment, and vehicle collisions would increase slightly. By contrast, Nighthawk and Bear Creek recreation sites would be expected to receive fewer visitors. Without vehicle access, there would no longer be any potential for vehicle-related mortality (collision), and less potential for disturbance or harassment. This benefit would extend along the entire length of the road from the South Shore Site to the end of the road.

Conditions at the South Shore and Trout Farm Road sites would likely remain about the same as under current conditions. No improvements are proposed at river access sites near the Powerhouse, the Old Gaging Station Road, Horseshoe Bend, or Diversion Dam, and conditions for wildlife at these sites would also remain about the same through the new license period.

Flow Discharge Structure

Construction of the proposed flow discharge structure would involve splicing a box-like concrete structure into the existing concrete flow line adjacent to the City's Diversion Dam. Construction would require removal of about 1,200 square feet of vegetation in an area characterized by mixed grass and forbs and a few scattered deciduous trees. The District anticipates that construction would last approximately 9 months, which would result in temporary, localized noise disturbance to wildlife.

Summary

In summary, the District's proposals to improve operations, aquatic resources, and recreation are likely to have small effects on wildlife. Over the long term, more disturbance would occur in some areas as a result of increases in recreation, while less disturbance would occur in other areas. Short-term, localized disturbance would be likely during construction of the new discharge structure and new recreation site, and improvements at existing recreation sites. Periodic, localized disturbance would occur during implementation of forest management activities.

Implementation of the District's proposed rule curves may alter the plant communities that occupy low elevation portions of some lake fringe wetlands, which may in turn alter wildlife use. Side channel enhancement may convert about 3 acres of shrub-scrub wetland currently not under the control of the District to open water habitat that can support salmonid rearing in the lower Sultan River. Constructing the new flow discharge structure, the new recreation site, and improvements at the South Fork Recreation Site would require removal of a total of approximately 3 acres of upland vegetation. These losses would be off-set by the District's protection and management of approximately 40 acres of wetlands, 57 acres of mapped riparian areas, and 2,295 acres of forested habitat, more than is needed to compensate for the effects of original Project construction, on-going Project operation, and proposed PM&Es.

E.6.4.4 Cumulative Effects

While continued operation of the Jackson Project would involve no harvest or modification of old-growth forest, it was suggested during the scoping process that operation of the Project could cumulatively affect old-growth. Old-growth forest contributes a key element to landscape biodiversity in the Pacific Northwest. An estimated 227 wildlife species use old-growth, and at least 68 species in western Washington are considered to be closely associated with old-growth and late-successional forest (Thomas et al. 1993).

The geographic scope selected for analysis of cumulative effects on old-growth forest is the Sultan River basin. At 110 square miles, the basin provides a landscape-level context for evaluating factors that affect the abundance and distribution of old-growth.

The primary factor affecting old-growth in the basin is timber harvest. Timber harvesting has occurred throughout the Sultan Basin, but subsequent conversion to agriculture, residential, commercial, industrial and infrastructure uses has been largely limited to the lower basin (below Culmback Dam). Timber harvest began in the late 1800s, and resulted in the loss of large areas of old-growth conifer forest prior to construction of Phase I of Culmback Dam in 1965. Timber harvest in Washington between 1965 and 1990 varied in response to economic pressures, from a peak of almost 8 billion board feet in 1973 to a little less than 5 billion board feet in 1981, but since the late 1980s, the combination of economic factors and environmental restrictions have resulted in a drop from year to year (Perez-Garcia and Barr 2005). In 2006, harvest levels in Washington totaled less than 4 billion board feet (OFM 2007). Data for Snohomish County reflect the same trends, with the total harvest declining from 108 million board feet in 2005 to 82 million board feet in 2006 (OFM 2007).

Most of the land within the Sultan Basin is in state ownership, with smaller amounts of federal and municipal land. The Washington DNR manages about 42 percent of its ownership in the basin (a total of 44,600 acres) for timber production. The remaining 58 percent is designated as the Morning Star Natural Resource Conservation Area (NRCA), where the goal is to protect natural resources, while providing for educational opportunities and low-impact uses. The Mt. Baker-Snoqualmie National Forest manages most National Forest System lands in the Sultan Basin (approximately 5,000 acres) as late-successional reserve (LSR). The LSR designation emphasizes protection of wildlife species associated with mature and old-growth forest.

Continued operation of the Jackson Project would result in no harvest of old-growth forest. The District proposes to implement a TRMP to manage habitat for wildlife on about 4,455 acres within the Sultan River basin. The TRMP would provide for protection of all existing old-growth forest within the proposed Project boundary, which totals about 502 acres, and management of about 1,850 acres of younger stands to promote the development of old-growth characteristics. Although these acreages represent a small fraction of the state and federal ownership within the Sultan Basin, their protection and management would contribute to cumulative benefits that are resulting from protection of old-growth and late-successional forest within the NRCA and LSRs.

E.6.5 Wetlands, Riparian Areas and Littoral Habitat

E.6.5.1 Affected Environment

This section summarizes the existing condition of wetland, riparian and littoral zone habitats within the Project area, defined here as the lands and waters within the FERC boundary and the five existing WHMP management areas (Figure E.6.4-1). This section also provides information about the condition of wetlands and riparian habitat along the Sultan River downstream of Culmback Dam. A summary of management activities that focus on these resources is included.

E.6.5.1.1 Within the Project Area

E.6.5.1.1.1 Wetlands

Project area wetlands provide habitat for many species, including black-tailed deer, bear, coyote, fox, bobcat, beaver, mice, and several species of birds and amphibians (WDG and Eicher Associates, Inc. 1982). Wetlands typically support high densities and numbers of species of songbirds and amphibians. Waterfowl, marsh birds, woodpeckers, and chickadees are among the many bird species that use Project wetlands. Pond-breeding amphibians known to occur in the Project area include western toad, Pacific tree frog, northern red-legged frog, northwestern salamander, rough-skinned newt, and bullfrog (WDG and Eicher Associates, Inc. 1982, DTA 2008).

Most of the non-forested wetlands in the Project area have high structural diversity due to the presence of open water, emergent and scrub-shrub habitat types. The most common plants in the non-forested wetlands are cattail, sedges, rushes, hardhack spiraea, devil's club, skunk cabbage, red-osier dogwood and pondweed. Yellow water-lily is present in several wetlands. Devil's club and skunk cabbage are common among forested wetlands. Willow, red alder, black cottonwood, vine maple and western redcedar are common around wetland perimeters.

The District has been conducting detailed wetland surveys since the summer of 2004 in order to develop an understanding of wetland functions and values, using the Washington State Wetland Rating System (Hruby 2004). The rating system is designed to evaluate the importance of wetlands based on several factors: 1) rarity in the landscape; 2) sensitivity to disturbance; 3) ability to perform many wetland functions well; 4) importance in supporting biodiversity; and 5) the difficulty of replacing the wetland type. Table E.6.5-1 presents the sizes, geomorphic classifications, and functional ratings of wetlands that were evaluated in the Wetland Surveys Technical Report (Tannenbaum and Bedrossian 2008). The report provides additional detail about the wetlands, and includes maps of their locations.

Table E.6.5-1 Wetland functional rating summary for Spada Lake, Williamson Creek, Lost Lake, and Lake Chaplain tracts.

Wetland # (Acres)	Name/Location	Wetland Class	Water Quality Score*	Hydrologic Score*	Habitat Score*	Total Score All Functions*	Wetland Category
#1 (11.4 ac.)	South Shore Recreation Site Wetland	Lake fringe	12	8	23	43	III
#2 (25.6 ac.)	Lost Lake Wetland (edge of lake)	Bog Depressional	11	10	31	52	I
#3 (7.5 ac.)	Lost Lake Tract SW corner	Depressional	15	28	26	69	II
#4 (2.5 ac.)**	Unit A. South Shore Road Wetland Complex (between South Shore and Nighthawk Rec. Sites)	Depressional	8	3	26	37	III
#4	Unit B. South Shore Road Wetland Complex (between South Shore and Nighthawk Rec. Sites)	Depressional	10	13	29	52	II
#5 (41.6 ac.)**	Unit A. Chaplain Marsh Wetland Complex	Depressional	10	6	30	46	III
#5	Unit B. Chaplain Marsh Wetland Complex	Depressional	9	6	32	47	III
#5	Unit C. Chaplain Marsh Wetland Complex	Depressional	12	16	25	53	II
#6 (3.0 ac.)	Williamson Creek Wetland (east of road)	Depressional	11	5	31	47	III
#7 (3.0 ac.)	Williamson Creek Arm Wetland	Lake fringe	12	8	24	44	III
#8 (8.5 ac.)	North Fork Arm Wetland	Lake fringe	12	8	25	45	III

Wetland # (Acres)	Name/Location	Wetland Class	Water Quality Score*	Hydrologic Score*	Habitat Score*	Total Score All Functions*	Wetland Category
#9 (1.9 ac.)**	Unit A. Upper South Shore Recreation Site Wetland Complex	Depressional	8	3	29	40	III
#9	Unit B. Upper South Shore Recreation Site Wetland Complex	Depressional	10	8	29	47	III
#9	Unit C. Upper South Shore Recreation Site Wetland Complex	Depressional	8	3	25	36	III
#9	Unit D. Upper South Shore Recreation Site Wetland Complex	Depressional	12	3	26	41	III
#10 (3.3 ac.)	North Shore Wetland	Depressional	8	3	27	38	III
#11 (3.3 ac.)	North Fork, South Shore Wetland	Lake fringe	10	8	19	37	III
#12 (3.6 ac.)**	Unit A. Lost Lake (west of ford)	Depressional	12	5	27	44	III
#12	Unit B. Lost Lake (west of ford)	Riverine	16	22	29	67	II
#14 (0.6 ac.)	South Fork Wetland 1	Depressional	8	5	20	33	III
#15 (1.5 ac.)	South Shore Wetland 1	Lake fringe	12	4	22	38	III
#16 (3.4 ac.)	South Shore Wetland 2	Lake fringe	12	12	23	47	III

Source: Tannenbaum and Bedrossian 2008

* Total possible scores for depressional wetlands: Water Quality Functions 32, Hydrologic Functions 32, Habitat Functions 36; All functions 100.
Total possible scores for lake fringe wetlands: Water Quality Functions 24, Hydrologic Functions 12, Habitat Functions 36; All functions 72.
Total possible scores for riverine wetlands: Water Quality Functions 32, Hydrologic Functions 32, Habitat Functions 36; All functions 100.

** Acreage of all wetland units in each complex is listed for sub-unit A of the complex.

Although most of the wetlands evaluated in this study are in relatively undisturbed (sometimes pristine) areas, most of their functional ratings and resulting category assignment are rather low[40]. The explanation for low scores lies in the premises of the wetland rating system. Under the Washington Wetland Rating System, a wetland is recognized as possessing the potential for performing a function, but its potential is qualified by its opportunity to perform that function. For example, wetlands that remove more pollutants are rated higher than those that remove fewer pollutants. The potential to perform this function is based on the physical, biological, and chemical characteristics of the wetland itself. Opportunity is based on the characteristics of the landscape in which the wetland is found, in this case the amount of pollutants that actually enter the wetland. A wetland located in a pristine area may have high potential to remove pollutants but no opportunity to do so because no pollutants ever reach it. In the Washington Wetland Rating System, the opportunity variable is a multiplier of 1 (no opportunity present) or 2 (opportunity present) for the potential variable. Thus the rating of a hypothetical wetland with no opportunity to remove pollutants would be relatively low.

Many of the wetlands in this study received relatively low scores for water quality and hydrologic functions, primarily because they are located in remote areas that do not provide the opportunity to perform these functions. Their total scores are largely a reflection of the habitat functions they provide. The highest functional rating in this study was determined for Wetland 2 (the Lost Lake bog, Category I) because it has a special characteristic (i.e. bog habitat). If it were not a bog, its score would have rated Category II because it has a low opportunity to provide water quality and hydrologic functions. Several other wetlands scored Category II (including Marsh Creek, Chaplain Marsh, and the oxbow wetlands on the lower Sultan River), primarily on the strength of the habitat values they provide and because they are located where they can perform hydrologic functions for downstream resources.

E.6.5.1.1.2 Riparian Areas

Numerous wildlife species are associated with riparian areas. Of 593 species that occur in Washington and Oregon, 319 use riparian habitats during all or part of their life cycle (Kauffman et al. 2001). Many of these species occur in the Snohomish basin. In addition to providing important foraging and nesting sites, their position in the landscape makes riparian areas especially important as corridors for wildlife movement, migration, and dispersal.

Riparian forests within the Project area are composed primarily of black cottonwood, bigleaf maple, and red alder. The understories include coniferous trees and shrubs such

[40] Category I wetlands are typically large, perform many functions well, provide habitat for special status species or regionally significant waterfowl concentrations, and/or have irreplaceable ecological functions. Category II wetlands are typically smaller, perform several functions well, support priority habitats and species, and may also include habitats that have irreplaceable ecological functions. Category III wetlands are also typically small, but perform few functions well, support less diverse vegetation, and may be more disturbed.

as western redcedar, vine maple, red huckleberry, snowberry and salal. Snags and down woody material are common.

Approximately 68.0 acres in the Project area are mapped as riparian forest. Additional riparian habitat occurs in narrow corridors adjacent to the numerous streams, creeks and rivers on existing WHMP lands, but cannot be quantified due to mapping constraints. About 48 additional unmapped acres of riparian forest lie along the Spada Lake shoreline between elevation 1,450 feet (normal maximum pool level) and 1,445 feet (normal full operational pool). These areas are rarely inundated as the normal full pool elevation is only exceeded during periods of high precipitation or flood events. Vegetation in this zone includes alder, western redcedar, black cottonwood, vine maple, bigleaf maple, red huckleberry, snowberry and salal. This area was not cleared prior to filling of the reservoir in an effort to maintain a riparian forest around the reservoir. The more flood-tolerant trees (alder and black cottonwood) survived. Conifers did not survive, but the snags that remain provide habitat for a number of wildlife species, including swallows, osprey, and bald eagles.

Riparian habitat is also present along the shorelines of Lost Lake and Lake Chaplain. These habitats are very different from each other in terms of their topography, soils, and hydrologic regime. Water levels in Lost Lake are relatively stable throughout the year. Floating bog, other vegetated wetlands, and mixed forest surround the open water portion of the lake. Lake Chaplain fluctuates about 5 feet seasonally in response to the City's water supply requirements. Lake Chaplain is surrounded by mixed forest, old-growth and second growth conifer stands, and grass meadow. With the exception of the gently sloping northeast corner and small pockets along the west side of the lake, the shoreline is relatively steep and the vegetation line is abrupt.

E.6.5.1.1.3 Littoral Zones

Wildlife using the shoreline and littoral zones of water bodies in the Project area include black-tailed deer, black bear, coyote, otter and waterfowl. Bald eagles, osprey and cavity nesting birds use the snags at Spada Lake that remain from those created when the reservoir was first filled.

The littoral zone of Spada Lake extends from elevation 1,445 feet msl (the target recreation level for June and July) downward to about 1,435 feet msl, the point where light in the water is insufficient for rooted aquatic plants to grow. The characteristics of vegetation in this zone are influenced by the variations in water levels for municipal water supply for the City, instream flows for the fishery below Culmback Dam, flood storage capacity for fall runoff, and recreation. Under current conditions, the summertime water level is lowered during August and the first half of September to ensure that water is available to meet these needs during periods of low inflow. The normal annual fluctuation is 40 feet (see Figure E.6.2-1 for rule curve). Vegetation is sparse where slopes are steep along Spada Lake Reservoir. .

The level of Lost Lake is stable throughout the year, and the shallow waters along the shoreline support a variety of rooted, floating aquatic and emergent plants. The Lake

Chaplain shoreline is generally steep and rocky, which limits the growth of emergent and aquatic vegetation in the littoral zone.

E.6.5.1.2 Downstream of Culmback Dam

Downstream of Culmback Dam, the Sultan River flows through a steep-sided canyon with walls rising from 200 to 800 feet before opening out to a broader floodplain as it nears the confluence with the Skykomish River (Snohomish County PUD 1983). Participants in the scoping process identified a need for quantitative information about this reach that could be used to evaluate Project effects on riparian and wetland habitat, as well as on aquatic habitat. The District conducted two studies that address this need. The Riverine, Riparian and Wetland Habitat Assessment (Stillwater Sciences and Meridian Environmental 2008a) used remote sensing techniques combined with field verification and GIS mapping to evaluate existing conditions and geomorphological influences that have occurred over time. The Physical Process Study focused on how Project operations may affect sediment and large woody debris transport, side channel connections, and the establishment or maintenance of riparian habitat (Stillwater Sciences and Meridian Environmental 2008b). In addition, the District conducted detailed wetland surveys at four sites along the river in order to evaluate wetland functions and values using the Washington State Wetland Rating System described in Section E.6.5.1.1 (Tannenbaum and Bedrossian 2008). The following sections briefly summarize the results of these studies, as they pertain to terrestrial resources. More detailed information can be found in the Riverine, Riparian and Wetland Habitat Assessment Technical Report (Stillwater Sciences and Meridian Environmental 2008a); Sultan River Physical Process Studies Final Technical Report (Stillwater Sciences and Meridian Environmental 2008b); and Wetland Surveys Technical Report (Tannenbaum and Bedrossian 2008). The amphibian study (DTA 2008) also provides information about wetland and riparian habitats along the Sultan River.

E.6.5.1.2.1 Wetlands

A total of 273.2 acres of wetlands were mapped within a study area that encompassed over 14,000 acres along the Sultan River between Culmback Dam and the confluence with the Skykomish River. Most of these wetlands are located outside the current and historical floodplain of the river; only 63 acres of wetlands were identified within the floodplain, outside the active channel.

Based on the Riverine, Riparian and Wetland Habitat Assessment (Stillwater Sciences and Meridian Environmental 2008a) and wetland surveys (Tannenbaum and Bedrossian 2008), only three wetlands that are outside the active river channel appear to be hydrologically connected to the Sultan River. Wetland 21 (6122 Road Wetland) is located approximately 3,000 feet downstream from the Culmback Dam. Wetlands 17 and 19 are located in abandoned oxbows on the east bank of the lower Sultan River just upstream of the City of Sultan, where the broad floodplain is marked by many former river channels and terraces.

Water supplying Wetland 21 originates from hillslope drainage. Although it discharges to the river, Wetland 21 is located at an elevation too high to receive water from the river under current flow conditions.

Wetland 17 receives flow through a culvert under Trout Farm Road (Winters Creek) and may receive drainage from a culvert under First Street in Sultan, although this culvert was higher than the channel at the time of the field visit (mid-June 2008), and there was no surface flow. Wetland 17 discharges to Winters Creek through a small beaver dam, which appears to control water levels in the wetland. Winters Creek is a tributary to the Sultan River.

Wetland 19 receives most of its water from upslope areas, probably through a culvert under Trout Farm Road. Water flowing into this oxbow joins a second oxbow, which receives flow from the Sultan River during annual high water periods (which included the field visit in early July 2008). Flow from the river follows a well-defined channel in the second oxbow through upland forested habitat for a short distance before flowing back into the Sultan River. During high water periods, water in the second oxbow creates additional ponding up stream in the lower portion of the first oxbow by backing up its flow.

Table E.6.5-2 presents the sizes, classifications, and functional ratings of these wetlands and a fourth wetland (Wetland 18, the Marsh Creek wetland) that was evaluated downstream of Culmback Dam as part of the Wetland Surveys (RSP 9) (Tannenbaum and Bedrossian 2008). Surface flow from a number of tributaries and subsurface drainage converges and ponds in a flat terrace east of the Sultan River to form Wetland 18. Wetland 18 receives water from Marsh Creek; there was no apparent outlet to this individual depressional wetland.

Table E.6.5-2 Sizes and classifications of wetlands on the Sultan River downstream of Culmback Dam.

Wetland # (Acres)	Name/ Location	Classification	Water Quality Score*	Hydrologic Score*	Habitat Score*	Total Score	Wetland Category
17 (6.6 ac.)	Oxbow 7	Depressional	20	6	28	54	II
18 (94 ac.)	Marsh Creek	Depressional	12	14	30	56	II
19 (0.5 ac.)	Oxbow 5	Depressional	20	6	29	55	II
21 (1.0 ac.)	6122 Road Wetland	Depressional	8	12	27	47	III

Source: Tannenbaum and Bedrossian 2008.

Inside the active channel of the Sultan River, a number of unconsolidated gravel bars and islands support hydrophytic vegetation. Plant species in these shrub/small tree communities include cottonwood, red alder, Pacific willow, and various wetland grasses and forbs. However, the gravel bars generally do not qualify as wetlands under the Wetland Rating System (Hruby 2004) because they are not inundated with sufficient frequency to have the potential to perform water quality or hydrologic functions.

The condition for evaluating a site as a riverine wetland is that overbank flooding occurs at least once every two years. Flows in the Sultan River are regulated by Culmback Dam, and only infrequent spill events or even more infrequent flood events would be sufficient to inundate these gravel bars. It is possible that they did perform wetland functions historically before Culmback Dam was constructed and flooding was more frequent, but currently they do not appear to have either the potential or the opportunity to do so. For this reason they are noted here (and depicted in mapping in the RSP 18 Technical Report), but they were not evaluated in this wetland study. In addition, shallows along the shorelines of the lower river support emergent wetland communities, but these were too small to be evaluated under the Wetland Rating System (Hruby 2004).

E.6.5.1.2.2 Riparian Habitat

As part of the Riverine, Riparian and Wetland Habitat Assessment (Stillwater Sciences and Meridian Environmental 2008a), the riparian area immediately adjacent to the Sultan River was reviewed to evaluate whether the continued operation of the Project and the regulation of river flows influence the plant community composition and seral stage development of these areas. Field verification of the cover type mapping provided an opportunity to observe the existing plant community composition at numerous locations along the river below the dam. The topography of the area immediately adjacent to the Sultan River and the history of land use practices has been the dominant influence on the existing vegetation composition in this area. Several distinct riparian segments were identified based on these features.

- **Segment 1** – Culmback Dam downstream to RM 12. This segment of the riparian area is east-west oriented and generally has long continuous slopes to the river, with only small bluffs immediately adjacent to the river.

- **Segment 2** – RM 12 downstream to RM 10. This segment of the riparian area is oriented in a northeast-southwest direction. There are long continuous slopes on the southeast side of the river similar to the segment immediately upstream. The northwest side of the river has a very steep, mostly inaccessible hillslope with some bluffs.

- **Segment 3** – RM 10 downstream to RM 3.3. This segment of the riparian area is mostly north-south oriented, has gently sloping topography set back from the river and tall steep bluffs immediately adjacent to the river.

- **Segment 4** –RM 3.3 downstream to mouth. This segment of the riparian area is north-south oriented with a broad flood plain on both sides of the river.

The riparian area in Segment 1 is dominated by mature coniferous forest on most of the hillslope above both sides of the river. The mature forest originated after timber harvest was conducted during the early to mid-1900s. Logging systems could not reach areas immediately adjacent to the river; therefore, there is generally an area of 100-200 feet upslope from the river where large trees persist.

There are very few flat areas immediately adjacent to the river in this segment, as the hillslope is continuous to the bank of the river. One flat area was observed immediately upstream of the miner and kayak access point, off of the 6122 Road. This site is a gravel and cobble bar that may become a side channel to the river during high flow events. The area is vegetated with a young alder sapling stand about 5-10 years old. Alder is an early successional species and commonly colonizes areas with high soil disturbance and low nutrient availability. The establishment of alder at this site indicates that normal successional patterns are occurring immediately adjacent to the river, that seed sources are available and being dispersed through the area, and that natural germination was not hindered by existing river flows. The young age of the trees also suggests that periodic inundation of this area precludes development of mature forest.

The riparian area in Segment 2 is dominated by mature coniferous forest on most of the hillslope on both sides of the river. On the southeast side of the river the vegetation composition and successional development are similar to the river segment immediately upstream. The old-growth forest was harvested to approximately 100-200 feet upslope of the river and this area has developed to a mature forest composition. On the northwest side of the river, steep slopes and bluffs have prevented the harvest of old-growth near the river, therefore the change in plant communities between old-growth and mature forest is further upslope than in other riparian segments. The northwest side of the river receives more sunlight than the upstream segment due to its orientation, and appears to be a drier site, possibly due to different soil and geological conditions. Mixed forest stands are common immediately adjacent to the northwest side of the river in this segment. No flat areas adjacent to the river were observed in this segment as the hillslope is generally continuous to the bank of the river and steep bluffs are common immediately adjacent to the river. Therefore, there is little opportunity for river flows to directly influence the development of vegetation immediately adjacent to the river.

The riparian area in Segment 3 is dominated by a mixture of mature and old-growth forest on both sides of the river. Immediately adjacent to the river, on both sides throughout this segment, there are very steep forested bluffs. Timber harvest has not occurred on these steep slopes and site disturbance is dominated by hillslope erosion, landslides, and windfall. There were no flat areas adjacent to the river observed in this segment, as the hillslopes are very steep. Therefore, there is little opportunity for river flows to directly influence the development of vegetation immediately adjacent to the river.

The riparian area in Segment 4 is dominated by forested stands of mid-successional and mature conifer, mixed, and deciduous cover. The topography immediately adjacent to the river in this segment is a gentle sloping low elevation floodplain. A wide range of land use activities occur within the riparian zone, and non-forested areas include pasture lands, rural residential development, city parks, and commercial buildings. The low gradient unconfined geomorphology of the river in this segment allows the river the opportunity for lateral migration and the deposition of sediment. These characteristics of the river create areas where lateral and mid-channel bars of sand, gravel, and cobble are created or exposed. Vegetation has established on many of these bars, trending from herbaceous species at lower elevations to deciduous or mixed forest at higher elevations. These successional changes are also reflected in the results of the Physical Process Study (Stillwater Sciences and Meridian Environmental 2008b), which indicated that vegetation encroachment in the lower alluvial reaches of the Sultan River has reduced the active channel area by 32 percent since current (Stage II) operations began. For this reason, side channels are relict features.

As part of the Instream Flow Study (R2 Resource Consultants 2008b), the District identified three side channels in the lower river (including the oxbow adjacent to Wetland 17) that could be reconnected to provide benefits for anadromous fish. The results of the study indicated that connectivity occurs at different flows (ranging from 200 to 375 cfs) at each side channel.

E.6.5.2 Project Effects

No concerns about wetlands within the Project area were identified during scoping, but the District included an evaluation of wetland management techniques it employs as part of the existing WHMP, in addition to conducting detailed evaluations of wetlands that could be affected by Project operations. Scoping identified the effect of continued Project diversions and flow releases on the distribution and quantity of riparian habitat along the Sultan River downstream of Culmback Dam as an issue to be analyzed. The discussion below addresses the effects of Project operations and other Project-related activities on wetlands and riparian areas.

E.6.5.2.1 Effects on Project Lands

E.6.5.2.1.1 Wetlands and Riparian Areas

Project operations would continue to affect fringe wetlands around Spada Lake as a result of reservoir fluctuations. Project operations and Project-related activities would also continue to affect some of the depressional wetlands on Project lands, as a result of implementation of the TRMP and provision of access to recreational facilities.

<u>Lake Fringe Wetlands</u>

The lake fringe wetlands at Spada Lake (Wetlands 1, 7, 8, 11, 15, 16 and 20) exist because of the reservoir; they were upland habitats before the Jackson Project was constructed. Their size varies from year to year depending on the timing and duration of inundation during the growing season. Some of them are vulnerable to invasive plant infestations from adjacent roads and recreation sites, and most currently support stands of reed canarygrass at elevation 1,435 and higher.

During the mid-1980s when the WHMP was developed, sparse sedges, rushes, grasses and forbs occurred as low as 1,435 feet msl. Since 1984, patches of dense wetland vegetation have established in relatively flat areas between 1,437 and 1,445 feet msl, such as the area to the west of the South Shore recreation site on Spada Lake and along the Williamson Creek arm, located at the northeast end of the reservoir. Where slopes are gentle, vegetation is present but often is sparse, patchy and interspersed with mud and gravel deposits, stumps and woody debris.

The District has tested methods of establishing vegetation in the drawdown zone of Spada Lake. Test plots of five wetland emergent species (*Carex obnupta*, *C. rostrata* [*C. utriculata*], *Sparganium* species, *Scirpus acutus* and *S. microcarpus*) were planted at two sites in October/November 1994 and monitored annually through 2000. They have been monitored periodically since 2000. Most plantings at the North Fork Sultan River site were damaged by wave action and floating debris, but two sedge species (*Carex* spp.) and small-fruited bulrush have become established and spread vegetatively at the Williamson Creek arm site. Natural in-seeding of wetland plants on both sites, especially small-fruited bulrush and other herbaceous species, has been far more effective in covering the ground than the test plantings (Snohomish County PUD 2005).

In Spada Lake, water surface fluctuation is the key factor that determines whether a wetland species can become established in the drawdown zone, and how far into the drawdown zone it will grow. In addition, wave scour and deposition of silt and gravel prevents revegetation of some portions of the drawdown zone with gentle slopes. The band between 1,438 feet and 1,441 feet was the most successful for both introduced and volunteer species. The limit for emergent species appears to be about 1,435 feet, below which the inundation season is too prolonged, even where wave scour is not a problem. Submergent and floating species, such as duckweed or pondweed, are establishing only sparsely at lower elevations in the drawdown zone, possibly because they also cannot tolerate the water level fluctuations and scour. The lower limit of the vegetated zone in Spada Lake will continue to change somewhat from year to year, but the overall area of vegetated wetland along the perimeter of the reservoir will not change appreciably under the new license. Vegetation will continue to be limited by the magnitude and timing of water level fluctuations.

The water surface elevation of Lost Lake is not affected by Project operations. The water surface elevation of Lake Chaplain, a City reservoir, is affected by the Project operation because of an agreement between the City of Everett and the District that allows the District to control the top 5 feet of Lake Chaplain surface elevations.

Depressional Wetlands and Riparian Areas

Under the existing WHMP, the District delineates and manages protective buffers around all Project-area wetlands. These buffers restrict construction or other ground disturbance near wetlands that could damage sensitive soils or native plants, or promote the establishment of noxious weeds. The wetland inventory identified several sites where buffers are especially important due to nearby recreational activity or vehicle traffic that could serve as a source of disturbance.

Wetlands adjacent to recreation sites (Wetlands 4 and 9) may be subject to invasive plant infestations due to recreation activity. Wetlands located near Project roads, including Wetlands 4, 5 and 9, could be subject to invasive weeds brought in by vehicles. Wetland 4 illustrates the vulnerability of roadside wetlands to weed infestations; the District has, and will continue to conduct, weed management activities at this wetland.

Wetlands 5 and 9 do not have significant weed populations. Lost Lake Wetlands 2 and 12 and Chaplain Marsh (Wetland 5) are located in proximity to roads, but do not currently support many invasive species because the level of traffic on these restricted-access roads is very low.

Wetland 18 (Marsh Creek wetland) has been severely damaged in the past by off-road vehicles but the DNR and District have effectively blocked access by installing a gate on the access road and boulders at the wetland. The wetland is less vulnerable to infestation of invasive weeds since public vehicle traffic was restricted.

<u>Summary</u>

In summary, the primary concern for wetlands on District lands in the upper Sultan basin is invasive weeds brought in by vehicles, heavy equipment, or other vectors along roads, trails, or at recreation sites. The District addresses this concern through on-going monitoring and management of weeds and protection of wetland buffers. No adverse effects of Project operations or Project-related activities on riparian habitat have been identified, but like wetlands, riparian areas may also be at risk of weed infestation where they are located near recreation sites or roads. The District provides on-going protection for riparian areas through management of riparian buffers to prevent or minimize vegetation and soil disturbance.

E.6.5.2.2 Effects Downstream of Project Area

E.6.5.2.2.1 Wetlands

The District conducted detailed evaluations of three wetlands located along the Sultan River downstream of Culmback Dam (Wetlands 21, 17 and 19). All were found to have hydrologic connections to the river under current conditions.

Wetland 21 is located in the bypass reach of the Sultan River. It discharges to the river but receives its hydrology from upslope, and is located at an elevation well above the river level under current operations. The topographic position of this wetland makes it unlikely that it ever would receive flows from the river, or be affected by Project-related alteration in flows.

Wetland 17 and Wetland 19 are located in abandoned oxbows in the alluvial reach of the Sultan River. Both are fed by tributaries and/or surface run-off. As a result of channel migration and possibly the regulated flow regime, Wetland 17 no longer receives water from the Sultan River, and does not discharge directly to it. Wetland 17 discharges into Winters Creek, a tributary to the Sultan River. Wetland 19 receives some water from the Sultan River during high flows via an oxbow that also discharges into the Sultan River. During high water periods, water in this lower oxbow backs up flow in the upper oxbow, resulting in an increased area of emergent and scrub/shrub wetland.

E.6.5.2.2.2 Riparian Habitat

The results of the Riverine, Riparian and Wetland Habitat Assessment (Stillwater Sciences and Meridian Environmental 2008a) indicated that along most of the Sultan River, side slopes are too steep to allow for much interaction between flows and vegetation, and the riparian zone is very narrow. Where topography allows, existing flow conditions appear to be supporting normal successional patterns, as evidenced by changes in the composition of vegetation along transects perpendicular to the river. In general, these show a gradient from unvegetated gravel bars, to herbaceous pioneer species, to shrubs (willow species and salmonberry), to young stands of small diameter deciduous species (alder and cottonwood), to mid-successional stands of deciduous and mixed species. It is likely that these successional changes are providing habitat for a wide range of wildlife species.

The results of the Physical Process Study (Stillwater Sciences and Meridian Environmental 2008b) indicate that the current flow regime is promoting the encroachment of riparian vegetation into the active river channel. While reducing the area of open water for fish, expansion of riparian plant communities likely provides additional cover and forage for wildlife species that use both aquatic and terrestrial habitats.

E.6.5.3 Proposed Environmental Measures

E.6.5.3.1 Wetland, Riparian and Littoral Zone Management

The TRMP (attached as Appendix E and discussed in Section E.6.4.3) will address protection of wetlands, riparian habitat and the Spada Lake littoral zone. Wetland and riparian management elements of the TRMP will focus on protection of buffer zones and management of activities (such as road construction or timber harvest) that are allowed in buffer zones. The TRMP will require stream and wetland buffers that meet or exceed the buffers required under Washington Forest Practices Rules (FPR). These buffers are the result of at least two decades of research on the needs of native salmonids, and have been endorsed by the USFWS and NMFS through the approval of a State-wide Habitat Conservation Plan.

<u>Wetlands</u>

Most of the wetlands on the TRMP Lands are located in areas without extensive development and are in fairly pristine condition. None have been identified as being in need of restoration. Wetlands are mapped, monitored, and buffered by District staff, but, with the exception of weed management at selected sites, no need for active management has been identified. As mentioned above, implementation of the proposed Noxious Weed Management Plan will provide a comprehensive, systematic approach to controlling existing weed occurrences and protecting these sensitive areas from future invasion. The District's proposal to convert the South Shore Road to a trail beginning at the South Shore Recreation Site would also reduce the potential for spread of invasive weeds to Wetland 4, and to other wetlands east of the site (Figure E.6.7-1).

Lake fringe wetlands could be affected by the proposed change in reservoir operation. As discussed in Section E.6.2.3.2.8, the reservoir rule curves are designed to balance water withdrawals to meet a variety of needs, including municipal water supply, power generation, recreation, and ecological functions. During high and average water years, the revised curves would be about the same as under current conditions. During low water years, the revised rule curve would reduce Spada Lake elevations more rapidly in late summer in order to provide more storage for potential high inflows during the wettest period of the year, in the fall. This change is intended to reduce the risk of spills in October, which could adversely affect spawning Chinook salmon. The proposed rule curve could also affect low-elevation portions of lake fringe wetlands by exposing them to drought stress more rapidly, earlier in the summer, and for a longer period of the growing season than under current conditions. Reed canarygrass is tolerant of a variety of moisture regimes, and for this reason, is likely to persist under new conditions, while the cover of native species growing in these fringe wetlands may be reduced. Reed canarygrass is well-established and widespread throughout the region; for this reason, Snohomish County does not require control. Overall, the effects of the revised rule curves would be minor, occurring only in drought years.

The District's proposal to improve side channel habitat along the lower Sultan River to provide salmonid rearing habitat may result in the conversion of about 3 acres of scrub-shrub wetland to open water. This measure is intended to restore habitat connectivity of side channels that have been lost as a result of controlled flows.

Riparian Habitat

The existing WHMP prescribes monitoring of stream buffer zones post-harvest. At the time it was written, the WHMP prescribed buffer zone widths that were wider than required under the Washington FPR, and included protection of all streams including Type 5 waters (which are generally intermittent or seasonal, or lack a well-defined channel). The FPRs were substantially revised in 2001. They now require larger buffers, on all perennial streams than were required in the past, and the widths of the buffers are based on site-specific conditions for maximum effectiveness. For some fish bearing streams, the FPR riparian buffers are now wider than the original WHMP buffers. Under the TRMP, the District will establish riparian buffers that represent the larger of the two options (WHMP and FPR) in all cases. All streams will have continuous, forested buffers. The result will be riparian forest protection in excess of any that is likely to occur on private forestlands in Washington.

In riparian areas downstream of the Powerhouse, implementation of the District's proposed minimum instream flows in the lower river may reduce riparian cover (through longer periods of inundation and altered timing and magnitude of peak flow events) at the lowest elevations it currently occupies, but may also provide increased soil moisture at higher elevations than under current conditions, allowing hydrophytic species to colonize areas slightly farther landward from the shoreline.

Changes in minimum instream flow releases would be greatest in the reach below the Powerhouse, increasing from 50 to 82 percent over existing conditions during the growing season. Changes between the Diversion Dam and the Powerhouse would range from 5 to 43 percent higher than current flows during the growing season. The net change in riparian habitat that might occur as a result of changes in minimum flows would likely be small, and would depend to a great extent on site-specific factors such as topography, soils, existing plant species, and adjacent land uses.

Minimum flows between the Diversion Dam and the new discharge structure, to be located about adjacent to the City's Diversion Dam, would not be reduced appreciably as the tailrace and entrance into the Sultan River will be at almost the same location as the current minimum flow is delivered. For this reason, construction of the new discharge structure would not affect riparian vegetation.

No significant changes in riparian habitat would be expected to result from the release of process flows because these releases would be limited in magnitude and duration. The maximum volume that could be released is 2,355 cfs for a total duration of about 113 hours. Process flows could be released continuously during this approximately 5-day period, or more realistically could be released in several events of shorter duration. Under either scenario, process flows would be smaller than peak flows that occur under existing conditions as a result of spill or intense precipitation.

No changes in riparian habitat would be expected to result from the release of whitewater boating flows. The District proposes to make 900 acre-feet of water available for these releases. A maximum flow of 1,200 cfs could be released for 9 hours, or a minimum flow of 450 cfs could be released for 24 hours. The magnitude, duration and timing of the releases would be determined as part of the Whitewater Recreation (WR) plan. Final flow determination for the remainder of the license period would be determined after completion of a 3-year study. Either scenario would provide flows that are lower than those that occur most years during winter storms.

The District proposes to release 800 to 1,200 cfs from the Powerhouse to support juvenile fish outmigration and adult fish upstream migration under certain conditions in non-drought years. Flows for smolt outmigration would likely occur for 12 consecutive hours on 3 separate days in May whereas flows for upstream migration would occur in September. Flows of this magnitude and duration are unlikely to result in measurable effects on riparian vegetation along the Sultan River below the Powerhouse.

E.6.6 Rare, Threatened and Endangered Species

For rare, threatened and endangered species, the Project area[41] is defined as the lands within the FERC boundary, lands the District manages for wildlife, and the waters of the Sultan River basin. The following sections describe existing conditions (including updated species lists, status, and new information obtained during focused studies in the Project area); discuss Project effects on species with special status; and present proposed PM&E measures where needed to address key resource issues. As mentioned in Section E.4.2, this section is intended to serve as the BA for the District's proposed action.

[41] The Project area is equivalent to the Action Area evaluated for potential effects on ESA-listed species.

E.6.6.1 Affected Environment

E.6.6.1.1 Rare, Threatened and Endangered Fish

As described in Section E.6.3.1, three species of fish in the Sultan River basin are currently listed as threatened under the ESA: Chinook salmon, steelhead trout, and bull trout. While not currently listed, the coho salmon is considered a federal candidate species and coastal cutthroat trout and Pacific lamprey are considered federal species of concern. A brief description of federally listed fish species follows. Detailed information on their life history, occurrence in the Sultan River, status, and local population trends is presented in Section E.6.3.1, as is the best available information on special status fish species (i.e., coho, cutthroat trout, and Pacific lamprey). Together, this information serves as the environmental baseline for this Biological Assessment.

Chinook Salmon

The Puget Sound Chinook Salmon Evolutionarily Significant Unit (ESU)[42] was listed as threatened under the ESA on March 24, 1999 (64 FR 14308) and reaffirmed on June 28, 2005. The ESU includes all naturally spawning Chinook populations residing below impassable natural barriers (e.g., long-standing, natural waterfalls) from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula (Table E.6.3-2). The naturally spawning population of Chinook salmon found in the Sultan River below the City's Diversion Dam is included in this ESU.

The ESA defines critical habitat for a threatened or endangered species as:

> *(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of Section 1533 of this title (e.g., the Federal ESA), on which are found those physical or biological features*
>
> *(I) essential to the conservation of the species, and*
>
> *(II) which may require special management considerations or protection; and*
>
> *(ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 1533 of this title (e.g., the Federal ESA), upon a determination by the Secretary that such areas are essential for the conservation of the species.*

NMFS issued a final rule designating critical habitat for Puget Sound Chinook salmon on September 2, 2005 (with an effective date of January 2, 2006). Designated critical habitat for Puget Sound Chinook salmon includes the mainstem Sultan River from its mouth to the Diversion Dam.

[42] A population that (1) is substantially reproductively isolated from conspecific populations and (2) represents an important component of the evolutionary legacy of the species.

According to NMFS, factors leading to the decline of Puget Sound Chinook salmon include a variety of human activities that have degraded extensive areas of spawning and rearing habitat. Threats to the Chinook salmon include watershed development such as forest practices, mining, agricultural land use, urbanization, hydropower, and water manipulation and withdrawal. Over-fishing, artificial propagation and introduction of nonnative species have also impacted populations throughout the ESU. Watershed development and associated urbanization have increased sedimentation, raised water temperatures, decreased LWD recruitment, decreased gravel recruitment, reduced river pools and spawning areas, and dredged and filled estuarine rearing areas. Development has also resulted in direct loss of riparian vegetation and soils and significantly altered hydrologic processes and erosion rates by creating impermeable surfaces such as roads, buildings, parking lots, and sidewalks (Bishop and Morgan 1996). In addition, large areas of lower river meanders (formerly mixing zones between fresh and salt water) have been channelized and diked for flood control and to protect agricultural, industrial and residential development (Bishop and Morgan 1996, Myers et al. 1998). Water diversions and hydroelectric dams have altered natural flow and water temperature regimes and prevented access to historical Chinook salmon spawning and rearing habitat, and harvest and hatchery practices have impacted the expression of the varied life history strategies throughout the ESU.

Under the ESA, the NMFS or USFWS is required to develop recovery plans for all threatened or endangered species. The purpose of recovery plans is to identify actions needed "for the conservation and survival" of species to the point that they no longer need the ESA's protection. On January 19, 2007, NMFS adopted a final ESA recovery plan for Puget Sound Chinook salmon (Shared Strategy Development Committee 2007). The plan includes specific protection and restoration actions for each watershed in the Puget Sound region as well as actions at the regional ESU scale.

The recovery strategy can be summarized as follows (Shared Strategy Development Committee 2007):

- Act immediately to protect functioning habitat and habitat-forming processes through a combination of regulatory, voluntary, and incentive-based tools.

- Prioritize, sequence, and implement habitat restoration actions according to the key factors and threats limiting recovery in each watershed and the Puget Sound nearshore and marine waters and estuaries.

- Implement the Puget Sound Harvest and Hatchery Resource Management Plans and Hatchery Genetic and Management Plans to ensure harvest and hatchery programs work in concert with recovery objectives.

- Address the three H-factors (habitat, harvest, and hatchery) in concert to sequence and synchronize activities between them to achieve recovery goals over time.

- Sustain existing and create new collaborative partnerships among stakeholder groups (e.g., farmers, foresters, environmentalists, all levels of government, etc.) at local and regional scales to resolve implementation issues.
- Address uncertainties through a robust regional adaptive management and monitoring program that is closely coordinated with local watershed, co-manager, state, and tribal adaptive management and monitoring programs.

Steelhead Trout

The Puget Sound steelhead DPS was listed as threatened on May 11, 2007 (72 FR 26722). The DPS includes all naturally spawned anadromous winter-run and summer-run steelhead populations, in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks. The majority of hatchery stocks are not considered part of this DPS because they are more than moderately diverged from the local native populations. Resident steelhead occur within the range of Puget Sound steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (71 FR 15666; March 29, 2006). Proposed critical habitat for Puget Sound steelhead is currently under review by NMFS.

Factors leading to the decline of the Puget Sound steelhead DPS are fundamentally the same as those described for Puget Sound Chinook salmon. These include habitat degradation associated with forestry, agriculture, hydropower, water diversions, and urban and rural development. Over-harvest has also reduced steelhead abundance throughout the DPS, and artificial propagation has posed a number of risks to natural population viability. While a recovery plan has not yet been developed for the Puget Sound steelhead DPS, many of the actions included in the recovery plan for Puget Sound Chinook salmon are expected to benefit Puget Sound steelhead.

Bull Trout

The Coastal/Puget Sound bull trout DPS was listed as threatened under the ESA on November 1, 1999 (63 FR 31693). The Coastal-Puget Sound DPS is comprised of all Pacific coast and Puget Sound bull trout populations within Washington State, including the Snohomish River and its tributaries. The USFWS designated critical habitat for the Coastal/Puget Sound bull trout DPS on September 26, 2005, effective October 26, 2005. While portions of the Skykomish and Snohomish rivers are considered critical habitat for bull trout, the Sultan River was not included in the final designation.

As described in Section E.6.3.1, both adult and sub-adult bull trout are believed to occasionally enter the Sultan River from the Skykomish River to forage on salmon eggs, salmon fry, or other prey. No bull trout have been observed in the Sultan River basin upstream of the Diversion Dam and it is unlikely that the reach downstream of Culmback Dam contains suitable spawning, incubation, or early rearing habitat for bull trout.

Bull trout have declined in the Coastal-Puget Sound DPS due to many of the same threats facing other listed salmonid species, including habitat degradation and fragmentation, blockage of migratory corridors, poor water quality and past fisheries management (Shared Strategy Committee 2007). They are particularly vulnerable to activities that warm their spawning and rearing waters, and have been heavily impacted by the introduction of non-native species such as brown, lake and brook trout. Commercial and recreational fisheries also continue to impact bull trout populations in the region, as they are occasionally caught in sport and commercial fisheries in Puget Sound, as well as by in-river net fisheries.

Bull trout in the Coastal/Puget Sound bull trout DPS are the subject of a draft recovery plan published in 2004 (USFWS 2004). According to USFWS (2004b), recovery for bull trout will entail reducing threats to the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms. In broad terms, these actions include:

- Protect, restore, and maintain suitable habitat conditions for bull trout.
- Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.
- Establish fisheries management goals and objectives for compatibility with bull trout recovery, and implement practices to achieve goals.
- Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.
- Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.
- Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitat.
- Assess the implementation of bull trout recovery by management units and revise management unit plans based on evaluations.

E.6.6.1.2 Rare, Threatened and Endangered Plant Species

E.6.6.1.2.1 Federally Listed Plant Species

The USFWS Western Washington field office web site indicates that no federally listed plant species are expected to occur in Snohomish County (USFWS 2006, USFWS 2007).

E.6.6.1.2.2 Other Special Status Plant Species

For the Jackson Project, special status plants include those listed by the USFWS as of concern at the federal level; those listed in Washington State as threatened, endangered, or sensitive; and those identified by the Forest Service as sensitive in Region 6. The Forest Service also maintains a list of rare or uncommon plants formerly identified as "survey and manage" species (USFS and BLM 2001, as amended). Based on their geographic range, known distribution, and habitat requirements, no federally listed species would be likely to occur in the Project area, but four federal species of concern[43] and several species with state or Forest Service status could be present (Smayda Environmental Associates, Inc.et al. 2008a). For this reason, the District conducted surveys for special status plants in 2007, covering a total of 594 acres (Smayda Environmental Associates, Inc. et al. 2008a). The surveys focused on habitats with a high probability of supporting rare plants (wetlands, native grasslands and meadows, riparian zones, old-growth forest, mature second-growth) and sites that could be affected by Project operations or Project-related activities. These included the Spada Lake shoreline, forested stands proposed for thinning or timber harvest by 2020, river access points, and forested habitats immediately adjacent to Project facilities and recreation sites. The surveys also included 40 acres of NFS lands near four river access trails along the bypass reach of the Sultan River.

None of the four federal species of concern were documented during the surveys. No state-listed species were documented during the surveys, but four lichen species with special status to the USFS – *Usnea longissima, Cetrelia cetrarioides*, *Hypogymnia duplicata*, and *Nephroma bellum* – were observed on lands within the District's ownership. None of the four are tracked by USFWS or the Washington Natural Heritage Program (WNHP), but the USFS considers all four as sensitive, rare or uncommon on NFS lands.

Usnea longissima was observed along the Sultan River near the Diversion Dam, at Chaplain Marsh, and along the shoreline of Spada Lake near major tributary streams, including Williamson Creek. *Cetrelia cetrarioides* was observed growing on red alder at one location near the Diversion Dam. *Hypogymnia duplicata* and *Nephroma bellum* were observed within old-growth habitat along Williamson Creek. *Hypogymnia duplicata*, a species epiphytic on conifers, was found on the ground within upland old-growth forest of western hemlock/devil's club/lady fern plant association; the source tree was not located. *Nephroma bellum* was growing on a stunted grand fir (*Abies grandis*) in a forested/shrub/emergent wetland complex within the old-growth stand.

The only special status species documented on NFS lands was *Usnea longissima*. This species was observed at several locations along the Sultan River and along the lower reaches of large tributary streams.

E.6.6.1.3 Rare, Threatened and Endangered Wildlife Species

The following sections provide information about the status, life history, and likelihood of occurrence of federally-listed wildlife species and other special status species that may be present in the Project vicinity. Table E.6.6-1 estimates the likelihood of occurrence of special status wildlife species in the Jackson Project area.

[43] "Species of concern" is an informal term referring to species that may be in need of conservation actions, but which receive no legal protection (USFWS 2008).

E.6.6.1.3.1 Federally Listed Wildlife Species

The USFWS Western Washington field office web site indicates that five federally listed wildlife species may occur in Snohomish County (USFWS 2007). These species are the Canada lynx, gray wolf, grizzly bear, northern spotted owl, and marbled murrelet. Designated critical habitat for two of these species – the northern spotted owl and marbled murrelet – is also present in Snohomish County.

<u>Canada Lynx</u>

The Canada lynx is a medium-sized cat with paws well-adapted to walking on snow. The Canada lynx inhabits moist coniferous forests with cold, snowy winters, where its primary prey is the snowshoe hare. The center of its range in North America lies in central Canada. The southern edge of the range extends along northern U.S. border from Washington to Maine, with extensions into the northern Cascades and the southern Rocky Mountains. Lynx in the U.S. occur at naturally low densities because of limited and patchy distribution of habitat that could support snowshoe hare populations (USFWS 2005).

Information on historical Canada lynx populations in the U.S. is scarce, owing to incomplete trapping data. Information about current populations in the U.S. is also scarce, as a result of low overall densities, the reclusive nature of this species, and the association of this species with remote habitats.

It is assumed that the species was never very abundant in Washington, which is located toward the southern extent of its range (Stinson 2001). Current population levels in Washington probably number fewer than 100 individuals (Stinson 2001). The last lynx harvested in Snohomish County was trapped in 1965 (Stinson 2001).

The Canada lynx was federally listed as a threatened species in 2000 in the lower 48 coterminous states (65 FR 16051). The USFWS completed a recovery outline in 2005, which established several core recovery areas in the northern United States (USFWS 2005). The North Cascades (approximately 70 miles from Spada Lake, at its nearest point) is the nearest core recovery area; secondary and peripheral recovery areas also occur along the Cascade crest (approximately 16 miles from Spada Lake at their closest points) and extend eastward.

The USFWS designated critical habitat for the Canada lynx in 2006 (71 FR 66008) and in 2008 proposed to revise the boundaries (73 FR 10860). There is no designated critical habitat for this species in Snohomish County; the nearest critical habitat unit is located about 70 miles (at its closest point) northeast of Spada Lake.

WDFW completed a recovery plan for lynx in Washington in 2001 (Stinson 2001). The plan delineates lynx management zones in the north-central and northeastern Washington; the nearest zone to the Jackson Project is in Chelan County, about 25 miles east of Spada Lake (Stinson 2001).

In Washington, the majority of lynx records and evidence of reproduction are from mature lodgepole, subalpine fir and spruce forests at elevations over 4,000 feet msl (McKelvey et al. 2000). The Jackson Project is located at elevations ranging from 146 feet msl at the Trout Farm Road River Access to 2,492 feet msl on the upper end of a steep unit of old growth above the South Fork Arm of Spada Lake. Due to low elevations and lack of lodgepole, subalpine fir, and spruce forest cover, it is not likely that lynx would ever be present in the Project area. The WDFW Priority Habitats and Species (PHS) database shows no lynx sightings in Snohomish County (WDFW 2009).

Gray Wolf

The gray wolf is the largest member of the *Canidae* family in North America. Its habitat requirements appear to center around the availability of unoccupied territory with a sufficient prey base (primarily big game), secluded den sites, and human tolerance of their presence.

Historically, the gray wolf ranged from coast to coast throughout much of the United States. Populations plunged to near extinction in the early 1900s, and currently, gray wolves are known only from Michigan, Minnesota, Wisconsin, Montana, Idaho, Wyoming, Arizona and New Mexico. As of 2006, the total population in the contiguous U.S. was estimated at a little over 5,000 animals (USFWS 2009).

Natural and re-introduced populations in Montana, Idaho, and Wyoming are currently expanding (USFWS 2007). As of 2008, the total northern Rocky Mountain population was estimated at about 1,645 wolves.

There have been several unconfirmed sightings from the vicinity of Ross Lake (over 50 miles away from the Project area), Glacier Peak Wilderness (the nearest boundary of the wilderness is about 16 miles east of Spada Lake), and Stevens Pass (located about 30 miles southeast of the Project area) over the past 15 or 20 years (WDFW 2009), and the number of reliable reports in Washington has increased since 2005 (WDFW 2008a). Most of the reports involve single animals, but biologists documented a pack with pups in Okanogan County in north-central Washington in July 2008. This is the first fully documented breeding by wolves in the state since the 1930s (WDFW 2008a). There are no confirmed reports of wolf sightings in the Project area.

The USFWS listed the gray wolf as an endangered species in the coterminous 48 states in 1978 (43 FR 9607), and designated critical habitat in Michigan and Minnesota. Since then, the protection status has changed in some locations, but in western Washington, the gray wolf is still listed as endangered. There is no federal recovery plan for wolves specific to Washington.

WDFW is in the process of developing a state-wide plan for conservation and management of this species (WDFW 2008a). The goal of the plan is to re-establish a naturally reproducing and viable population, distributed in a significant portion of the species' former range.

Gray wolves could use habitat in the Williamson Creek and Spada Lake tracts in the future, if populations of this species in the North Cascades expand. Protection of these lands from timber harvest, development and motorized access would provide a large block of suitable and relatively undisturbed habitat, contiguous with similar habitat in the Morning Star NRCA and Mt. Baker-Snoqualmie National Forest Late Successional Reserves (LSRs). However, reduced timber harvest on Jackson Project lands and adjacent public lands would reduce the availability of deer and elk (wolf prey), which are more abundant in areas having a patchwork of successional forest types.

Grizzly Bear

The grizzly bear is one of the largest terrestrial mammals in North America, sometimes reaching more than 800 pounds. Grizzly bears are wide-ranging and use a variety of habitats, from low elevation wetlands and riparian areas to dense forests on steep sideslopes, to sub-alpine meadows and shrublands. Habitat use is seasonal, to a large extent, and depends on available forage resources. Grizzly bears rely primarily on green vegetation, bulbs, roots, fruits, berries, and nuts, with only 10 to 20 percent of the diet coming from big game and small mammals, and salmon where available. In the fall, grizzly bears typically select den sites at high elevation, where snow will accumulate through the spring.

The grizzly bear's historic range covered most of western North American from Alaska to central Mexico and eastward to the plains states. Populations in the late 1800s are estimated to have been about 50,000 bears. Currently, grizzly bears occur in the U.S. only in Washington, Idaho, Montana, and Wyoming, and the total population is estimated at 1,200 to 1,400 bears.

The USFWS listed the grizzly bear as a threatened species in 1975 in the lower 48 coterminous states (40 FR 31734). In 1991, the USFWS determined that listing the grizzly bear as endangered was warranted but precluded by higher priority actions (56 FR 33892). The USFWS has not designated critical habitat for this species, opting instead to establish recovery zones. The North Cascades zone covers about 10,000 square miles of north-central Washington. Spada Lake is located at the southwestern-most edge of this zone. Current populations in this zone are unknown, but may number fewer than 20 animals; without augmentation, USFWS concludes there is a low likelihood of recovery (USFWS 2004a). The most recent sighting in the Project vicinity was documented in 1994, about 5 miles northeast of the Williamson Creek Tract (WDFW 2009). Other documented historical occurrences northeast of this tract were over 10 miles away.

The Jackson Project area provides some potential grizzly bear habitat in undeveloped, forested areas in the Williamson Creek and Spada Lake tracts. Grizzly bears could occur in the future as transients, but only if populations in the North Cascades Recovery Zone are augmented and/or expand as a result of other recovery actions.

Northern Spotted Owl

The northern spotted owl is a medium-sized owl, cryptic in nature and coloration, closely resembling its near relative the barred owl (*Strix varia*). Northern spotted owls are principally nocturnal and spend most daylight hours inconspicuously perched in protected roost locations. Nest sites are generally in previously excavated cavities or in platform nests built by other species (USFWS 1992). Established pairs normally remain in the same territories from year to year and foraging areas may reach over 6,000 acres (USFWS 1992).

No information is available on the numbers of birds or the distribution of the northern spotted owl prior to the arrival of settlers and subsequent harvest of lowland forest. The final recovery plan (USFWS 2008a) indicates that as of 1994, over 5,000 nesting pairs or resident single birds were recorded in Washington, Oregon, and California. However, the actual number of currently occupied northern spotted owl locations across their range is unknown. Not all potential habitats have been or can be surveyed, and many historical sites are no longer occupied, due to displacement by barred owls or loss of habitat to timber harvest or fire (USFWS 2008a). In addition, the presence of barred owls may inhibit the smaller northern spotted owl from calling, which complicates the use of standard survey procedures, and thus, accurate estimates of northern spotted owl nesting activity (USFWS 2008a). Although current data are insufficient to draw conclusions as to regional or local population trends, statistical analysis suggests the population in 13 long-term demographic study areas in Washington, Oregon and California declined about 3.7 percent between 1985 and 2003 (USFWS 2008a).

The northern spotted owl was federally listed as a threatened species in 1990 (55 FR 26114). The USFWS issued a final recovery plan in May 2008 (USFWS 2008). The plan identifies actions aimed at conserving and managing habitat and controlling barred owls, following a strategy designed for evaluation and adaptive management over the next ten years. Based on Recovery Action 4 of the plan, the USFWS revised the designation of critical habitat in August 2008 (73 FR 47325). The designated critical habitat provides a network of mapped owl conservation areas (MOCAs) that are of sufficient size and spacing to achieve long-term recovery of spotted owls. The USFWS designated six MOCAs in Snohomish County, which are all part of the Northwest Washington Cascades Critical Habitat Unit. The designation includes only federal lands, and the MOCA boundaries generally encompass NFS lands managed as Late Successional Reserves under the Northwest Forest Plan (USFS and BLM 1994).

Critical habitat designation for the northern spotted owl is based on protection of primary constituent elements (PCEs) needed to support the species. PCEs for northern spotted owl include (1) the appropriate forest type (e.g., western hemlock, mixed conifer, Pacific silver fir, Douglas-fir); (2) nesting habitat comprised of stands with a moderate to high canopy closure; a multi-layered, multi-species canopy with large diameter overstory trees; high incidence of large trees with various deformities; large accumulations of fallen trees and other woody debris on the ground; and sufficient space for flight below the canopy; (3) roosting habitat (similar to nesting habitat, except that it need not contain specific structural features used for nesting; (4) foraging habitat, which contains some roosting habitat attributes, but can also consist of more open and fragmented forests; and (5) dispersal habitat, containing stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities (73 FR 47325).

Critical habitat nearest the Jackson Project is located approximately 1 mile outside the Project area on NFS lands near Williamson Creek, about 3 miles north of Spada Lake. The Mt. Baker Snoqualmie National Forest manages these lands according to standards and guidelines contained in the Northwest Forest Plan for Late Successional Reserves and Late Successional Old-Growth areas (USFS and BLM 1994). The Northwest Forest Plan also contains standards and guidelines for management of NFS lands that are not designated as critical habitat, to protect or improve ecological functions that contribute to habitat quality for northern spotted owl and other species. For example, the Mt. Baker-Snoqualmie National Forest applies these standards and guidelines to NFS lands along the Sultan River that are allocated as Riparian Reserve (see Section 5.7, Recreation and Land Use).

The Washington State Forest Practice Rules apply to management of northern spotted owls on non-federal lands in Washington, including District lands. The rules restrict the harvest of suitable spotted owl habitat under certain circumstances. The DNR protects and manages owl habitat on its ownership through its federal Habitat Conservation Plan (DNR 1997).

Very few northern spotted owl sites are currently known in the Project vicinity. A single resident northern spotted owl site is located on the Pilchuck River drainage about 3 miles northwest of Culmback Dam (WDFW 2009). A previously active site of a reproductive pair is located over 1 mile northeast of the Williamson Creek Tract, although the current status of the site is unknown.

To further evaluate habitat conditions and potential owl occurrence in the Project area, the District conducted focused surveys for northern spotted owls in the Project area in 2007 and 2008. The study was completed in three phases: habitat assessment, survey station layout, and surveys.

Habitats were assessed for suitability by using aerial photos, cover type maps, stand inventory information on tree density and tree size, and field verification. Following the assessment, surveyable habitat (habitat of sufficient quality and quantity to warrant surveying) was divided into three survey areas with potential for spotted owl use: Lake Chaplain, Spada Lake/Section 30, and Williamson Creek. Survey stations were established in each area, consistent with the USFWS protocol (USFWS 1992).

Three complete survey visits were conducted to each survey area in 2007, and three in 2008, following USFWS (1992) protocol for a 2-year survey. No spotted owls were detected in either year, and no follow-ups were required. Several other owl species were detected. Survey visits and owl detections are documented in the Northern Spotted Owl Survey report (Biota Pacific 2008a).

Marbled Murrelet

The marbled murrelet is a seabird that nests as far as 50 miles from the coast along the shorelines of Washington. It is typically associated with old-growth conifer forests, but nests have also been documented in younger, mixed stands where deformities are used as nest platforms; the murrelet does not build a nest, instead laying a single egg in a mossy depression on a large-diameter branch, or where mistletoe infection or other defects provide a suitable nest platform. Both adults attend the nest, bringing fish from foraging areas in nearshore saltwater to the young. Adults are most active at nest sites at dawn and dusk.

Marbled murrelets are occasionally observed resting or foraging at inland lakes (Carter and Sealy 1986). Most observations are from lakes located within 12 miles of saltwater, but a few observations have been documented at lakes in British Columbia that are located over 30 miles from the coast. During summer surveys conducted for WDFW in 1991 through 1994, up to five marbled murrelets were observed above and on Lake Chaplain at one time (Cross 1994).

The marbled murrelet was federally listed as a threatened species in 1992 in Washington, Oregon, and California (57 FR 45328). The USFWS designated critical habitat for the marbled murrelet in 1996 (61 FR 26255), and prepared a recovery plan in 1997 (USFWS 1997). The USFWS issued a proposed rule to revise the critical habitat designation in Oregon and California in July, 2008 (73 FR 44678). The critical habitat designation is based on PCEs which include forested stands containing trees with potential nesting platforms, and the surrounding forested areas within 0.5 miles of these stands that have a canopy height of at least one half the site-potential tree height[44]. Currently there is no proposal to revise the critical habitat designation in Washington, which includes federal and state lands surrounding most of the Jackson Project area. No Project lands are designated critical habitat for the marbled murrelet.

On NFS lands near the Jackson Project, the Northwest Forest Plan provides standards and guidelines for management of potential marbled murrelet habitat. The DNR's Habitat Conservation Plan (HCP) addresses murrelet protection on DNR lands in the Project vicinity (DNR 1997). Marbled murrelet habitat is protected on private lands in Washington under the State Forest Practice Rules. In accordance with these rules, the District applies "disturbance avoidance" measures to activities such as forest thinning or road repairs, when they occur within 0.25 mile of documented "occupied marbled murrelet sites". "Disturbance avoidance" measures are intended to prevent noise from adversely affecting nesting birds.

To further evaluate the potential for Project effects on marbled murrelets, the District conducted a habitat assessment and field surveys for this species in 2007 and 2008 (Biota Pacific 2008b). Based on the results of the habitat assessment, biologists delineated eight marbled murrelet survey areas. Survey stations were then established to ensure that all suitable habitat was covered during each year of survey. Surveys were conducted in accordance with the Pacific Seabird Group marbled murrelet survey protocol (Evans Mack et al. 2003).

During the two years of surveys, marbled murrelet occupancy was detected in two survey areas (Culmback West and Williamson Creek North). Three other survey areas

[44] Site potential tree height is based on species-specific site index tables, and is defined as the average maximum height that a tree will attain, given the local growing conditions.

(Culmback East, Olney Pass and Williamson Creek South) are contiguous with the first two, so they too are considered to be occupied by marbled murrelets. A sixth survey area (South Fork Spada Inlet) is contiguous with habitat found to be occupied in the 1990s, so it too is considered to be occupied. No marbled murrelets were detected at Lake Chaplain and Horseshoe Bend.

E.6.6.1.3.2 Other Special Status Wildlife Species

The following sections and Table E.6.6-1 present information about USFWS candidates for listing; USFWS species of concern (USFWS 2007); species that are listed as threatened or endangered at the state level or are considered sensitive in Washington (WDFW 2008b); or designated as sensitive in Forest Service Region 6 (USFS 2008).

In Table E.6.6-1, an estimate of “possible” occurrence means that the Project area is located within the geographic and elevation range typical of the species and provides habitat used by the species during at least one life stage. An estimate of “unlikely” indicates that the Project area is located outside the known range of the species and/or provides no suitable habitat. Species shown as “documented” in the Project area are those reported by District staff during regular Project operations, observed during pre-licensing surveys in the early 1980s (WDG and Eicher Associates, Inc. 1982), or documented during surveys conducted in the Project area in 2007 and 2008 (Biota Pacific 2008a, Biota Pacific 2008b, DTA 2008).

The USFWS currently identifies two candidates for listing – yellow-billed cuckoo and Oregon spotted frog – as possibly occurring in Snohomish County (USFWS 2007a). The USFWS determined that listing of the species is warranted because of the magnitude of imminent threats, but listing has been precluded by higher-priority actions (79 FR 60933).

The yellow-billed cuckoo once nested in deciduous woodlands and riparian shrub along rivers and streams throughout Washington. There have been occasional reports of occurrences in Washington since 1934, including sightings in July and August of 1979 in a cottonwood grove along the Snohomish River near Sultan (Birdweb undated). The WDFW PHS database reports one sighting in 2000 over 23 miles from the Project area (WDFW 2009).

Almost entirely aquatic, the Oregon spotted frog is associated with lakes, ponds, and slow-moving streams. The historic range of the Oregon spotted frog extended throughout the Puget Sound lowlands and into the Cascade foothills. The WDFW PHS database shows no sightings in Snohomish County (WDFW 2009). Currently, the only known populations are in Thurston and Klickitat counties (WDFW 1997). Studies conducted in support of Project relicensing failed to detect spotted frogs on or near Project lands (DTA 2008).

Table E.6.6-1 Special status wildlife species documented in Snohomish County or known or suspected to occur on the Mt. Baker-Snoqualmie National Forest that may occur within the Jackson Project area.

Scientific Name	Common Name	Status[a]	Likelihood of Occurrence in the Jackson Project Area, Based on Range, Elevation and Habitat	PHS Database Records for Snohomish Co.
INVERTEBRATES				
Agonum belleri	Beller's ground beetle	FCo, SC	Possible; sphagnum bogs near the margins of lakes below 3,000 feet. Currently known in Washington only in King County.	None
AMPHIBIANS				
Ascaphus truei	tailed frog	FCo	Documented in several tributaries to Spada Lake (RSP 10); cold, rocky, high-gradient streams.	Several sightings north and east of Project area, including 2 within 2 miles of Spada Lake.
Bufo boreas	western toad	FCo, SC	Documented in Spada Lake Tract (RSP 10); breeds in wetlands, ponds, small lakes and the backwaters of large rivers, but largely terrestrial and often observed in upland forests and shrub thickets.	Several sightings over 3 miles north of the Project and 1 within 1 mile of the Williamson Creek Tract.
Rana cascadae	Cascades frog	FCo	Documented (RSP 10); in or near streams, bogs, fens, forested swamps, small lakes, ponds and marshy areas, usually from 2,000-6,000 feet.	Several to the north of the Project area, approximately 2 miles away.
Rana pretiosa	Oregon spotted frog	FC, FSS, SE	Unlikely; in or near perennial springs, ponds, lakes, or slow-moving streams with abundant emergent or floating aquatic vegetation.	None
BIRDS				
Accipiter gentilis	northern goshawk	FCo, SC	Likely; nests and hunts in old-growth and mature conifer forest. Observed in Project vicinity.	Closest approximately 1.5 miles from the Project area.

Scientific Name	Common Name	Status[a]	Likelihood of Occurrence in the Jackson Project Area, Based on Range, Elevation and Habitat	PHS Database Records for Snohomish Co.
Aechmophorys occidentalis	western grebe	SC	Documented; occasional migrant; breeds in eastern Washington, common along the coast and Puget Sound during winter.	None
Aquila chrysaetos	golden eagle	SC	Documented; hunts over open ground, nests in rocky cliffs and open woodlands at mid-elevations.	Closest 9 miles south of Project area.
Brachyramphus marmoratus	marbled murrelet	FT, ST	Documented presence and occupancy (RSP 11). Forages at sea in near-shore waters; nests in mature or old-growth conifer stands or younger stands with nest platforms.	Numerous north of Project area. Observed on Lake Chaplain. Occupancy detections west of Culmback Dam; detections in North and South Fork Sultan River drainages.
Buteo regalis	ferruginous hawk	ST	Unlikely; breeding in Washington restricted to arid south-central shrub-steppe and grasslands; winters primarily in southwestern U.S. and Mexico.	None
Chaetura vauxi	Vaux's swift	SC	Documented; nests and feeds in mature and old-growth forests with abundant snags.	North and west of Project area. Closest ~5 miles away.
Coccyzus americanus	yellow-billed cuckoo	FC, SC	Unlikely; once occupied deciduous woodlands and riparian shrub throughout Washington; now thought to be extirpated in the state.	One over 23 miles away, southwest of Project area.
Contopus cooperi	olive-sided flycatcher	FCo	Documented; nests and feeds in uneven-age, snag-rich conifer stands near clearings, burns or water bodies.	None

Scientific Name	Common Name	Status[a]	Likelihood of Occurrence in the Jackson Project Area, Based on Range, Elevation and Habitat	PHS Database Records for Snohomish Co.
Dryocopus pileatus	pileated woodpecker	SC	Documented; nests and feeds in closed canopy forest with abundant large-diameter snags, stumps and dead and down materials.	North of Lake Chaplain over 5 miles from Project area.
Falco columbarius	merlin	SC	Documented; likely a migrant; usually breeds at high elevations in conifer forest edges near lakes or rivers.	None
Falco peregrinus	peregrine falcon	FCo FSS, SS	Possible; may forage in the vicinity; hunts over rivers, streams, and in open riparian forests; nests on cliffs.	South and north of Project area. Closest over 6 miles away.
Gavia immer	common loon	FSS, SS	Documented during summer in and near Spada Lake and Lake Chaplain; may breed in the Project area. Thought to prefer relatively secluded lakes with abundant vegetation. Winters along Pacific coast.	Lake Chaplain
Haliaeetus leucocephalus	bald eagle	FCo, FSS, SS	Documented; nests in large-diameter canopy-dominant trees, usually in conifer stands along the coast or near rivers, lakes or reservoirs. Perches in large-diameter deciduous or conifer trees that afford good views of foraging areas.	Lake Chaplain Numerous sightings in Snohomish County
Otus flammeolus	flammulated owl	SC	Unlikely; breeding in Washington occurs on the east slope of the Cascades, Okanogan Highlands, and Blue Mountains; winters in Mexico and Central America.	None

Scientific Name	Common Name	Status[a]	Likelihood of Occurrence in the Jackson Project Area, Based on Range, Elevation and Habitat	PHS Database Records for Snohomish Co.
Strix nebulosa	great gray owl	FSS	Documented by District biologist at the north end of Lost Lake, perched in a cedar; known to breed only in eastern Okanogan and western Ferry counties, but may occur as an occasional winter visitor.	None
Strix occidentalis caurina	northern spotted owl	FT, SE	Documented in vicinity; nests in old-growth conifer forest or younger stands with old-growth characteristics (multi-layer, large-diameter snags, abundant dead and down material); uses younger stands for roosting, foraging and dispersal.	Single resident site, Pilchuck River drainage ~3 miles NW of Culmback Dam. Reproductive site located over 1 mile NE of Williamson Creek Tract.
MAMMALS				
Canis lupus	gray wolf	FT, SE	Unlikely; no recent occurrences in Snohomish County. Uses a variety of habitat types, depending on availability of unoccupied territory with a sufficient prey base (primarily deer and elk), isolated den sites, and human tolerance of their presence.	None
Corynorhinus townsendii townsendii	Pacific Townsend's big-eared bat	FCo, FSS, SC	Possible; uses several forest types and commonly feeds along roads or open areas, rather than over water. Roosts in caves, buildings, abandoned mines.	North of Spada Lake over 17 miles away from Project area.
Gulo gulo luteus	California wolverine	FCo FSS, SC	Unlikely; no recent occurrences in Snohomish County. Inhabits closed-canopy, mature or older conifer or mixed forests, denning in hollow logs or snags, tree cavities and brush piles.	Over 3 miles away from Project area on South Fork Sultan River.

Scientific Name	Common Name	Status[a]	Likelihood of Occurrence in the Jackson Project Area, Based on Range, Elevation and Habitat	PHS Database Records for Snohomish Co.
Lynx canadensis	Canada lynx	FT, ST	Unlikely; dens typically in high-elevation mature lodgepole, spruce or subalpine fir forests; may forage in younger stands where snowshoe hare are abundant.	None
Martes pennanti	Pacific fisher	FCo, SE	Unlikely; no recent occurrences in Snohomish County. Found primarily in mature, closed-canopy forests interspersed with wetlands, riparian habitat and small openings.	None
Myotis evotis	long-eared myotis	FCo	Possible; uses several forest types at low to mid-elevation for foraging (gleaning insects from foliage); roosts in trees, buildings, and caves.	None
Myotis volans	long-legged myotis	FCo	Possible; found primarily in conifer forests along rivers and streams. Roosts in buildings, rock crevices, ground fissures, under bark.	None
Ursus arctos horribilis	grizzly bear	FT, SE	Unlikely; no recent occurrences in Snohomish County. Uses a variety of habitats at various elevations, depending on seasonal forage resources.	1994 ~5 miles NE of Williamson Creek Tract; others NE of tract over 10 miles away.

Source: WDG and Eicher Associates, Inc. 1982; Smith et al., 1997; USFS 2008; USFWS 2004b; WDFW 2009; District staff; Biota Pacific 2008a

[a] Status Codes:

FE = Federal Endangered
FT = Federal Threatened
FC = Federal Candidate Species
FCo = Federal Species of Concern; species appears to be in jeopardy, but information is insufficient to support listing.
FSS = Forest Service Sensitive; on Regional Foresters' List of Sensitive Species for Region 6.
SE = State Endangered; in danger of becoming extinct or extirpated from Washington
ST = State Threatened; likely to become endangered in Washington
SC = State Candidate Species
SS = State Sensitive; vulnerable or declining and could become endangered or threatened in Washington

E.6.6.2 Project Effects

E.6.6.2.1 Rare, Threatened and Endangered Fish

Several relicensing studies were implemented to quantify Project effects on rare, threatened or endangered fish. Section E.6.3.2, Project Effects, includes a detailed discussion of effects of existing Project operations on fish and aquatic habitat in the Sultan River. To supplement this analysis and facilitate ESA consultation, we are also providing the following analysis of existing Project effects on the listed species' specific freshwater habitat requirements or "primary constituent elements" (PCEs) (NMFS 1996).

PCEs are physical and biological requirements that are essential to the conservation of a given species. These include, but are not limited to: space for individual and population growth, and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. In the September 2, 2005, critical habitat designation, NMFS further defined PCEs for listed salmon and steelhead as sites essential to support one or more life stages of the ESU (sites for spawning, rearing, migration and foraging). These sites in turn contain physical or biological features essential to the conservation of the ESU/DPS (for example, adequate spawning gravels, water quality and quantity, side channels, forage species). Specifically, the primary constituent elements determined essential to the conservation of salmon and steelhead are:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development;

- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;

- Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;

- Estuarine areas free of obstruction with water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels, and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;

- Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulder and side channels; and

- Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

For proposed actions that have the potential to affect freshwater habitat, NMFS usually defines these PCEs in terms of a habitat condition concept called properly functioning condition (PFC) (NMFS 1996). PFC is the sustained presence of natural habitat forming processes in a watershed that are necessary for the long-term survival of the species through the full range of environmental variation.

Within the PFC framework, baseline environmental conditions (water temperature, physical barriers, substrate, pool frequency, etc.) are described as properly functioning (PF), at risk (AR), or not properly functioning (NPF). If a proposed action is likely to impair properly functioning habitat (Impair), appreciably reduce the functioning of already impaired habitat (Reduce), or retard the long-term progress of impaired habitat toward PFC (Retard), it is usually found to be likely to jeopardize the continued existence of the species, or adversely modify its critical habitat, or both, depending on the specific consideration of the analysis. Such considerations may include, for example, the species' status, the condition of the environmental baseline, the particular reasons for listing the species, any new threats that have arisen since listing, and the quality of available information. Actions which do not compromise a species' biological requirements to the degree that appreciably reduces their viability and chances of survival in the Action Area are considered not to reduce, retard, or impair (NR).

In Table E.6.6-2, we summarize the existing baseline environmental conditions for the Jackson Project Action Area including existing Project operations, and present the status of each indicator as PFC, AR, or NPF following the "Matrix of Pathways and Indicators" (NMFS 1996) (Appendix F). The effects that the proposed action may have on each environmental indicator included in the Matrix of Pathways and Indicators are analyzed subsequently in Section E.6.6.3.1.3. As noted in FERC (2001), the environmental baseline used in this assessment includes the past and present impacts of all federal, state, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed federal projects in the Action Area that have already undergone formal or early ESA Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process 50 CFR § 402.02(d) (i.e., the Project facilities are currently in place and are part of the existing baseline). Because ESA-listed fish species were not historically present in the Sultan River upstream of Culmback Dam, the geographic scope of this analysis (the proposed Action Area) is limited to the mainstem Sultan River downstream of Culmback Dam. This is the area in which there could be direct or indirect effects to Chinook and steelhead from continued Project operation under a new license.

Table E.6.6-2 Application of "Matrix of Pathways and Indicators" (NMFS 1996) to environmental baseline conditions in the Jackson Project area.

	Baseline Environmental Conditions		
Pathway Indicators	Baseline Function	Description	Cause of Degradation from PFC
Water Quality			
Temperature	AR (OR-1) AR (OR-2)	Overall, water temperature monitoring results indicate that maximum water temperatures have been consistently cooler under Stage II operations compared to Stage I operations, especially during the summer. These cooler daily maximum temperatures under Stage II operations demonstrate the beneficial effects of the water intake control structure (see Section E.6.2.2.2.1). However, a few slight exceedences of state standards occur, but are rare. For example, A 7-DADMax value of 6.1 °C was recorded at the monitoring site near the Sultan River mouth (RM 0.2) on September 8, 2007.	Water temperatures in OR-1 and OR-2 have been altered by seasonal changes in hydrology associated with the operation of the Jackson Project.
Sediment/Turbidity	AR	Turbidity grab sample values in the Sultan River downstream of Spada Lake were less than 5 NTU in 77 to 92 percent of grab samples obtained during the 2007 and 2008 water quality study. Grab sample values at lower Sultan River sites were relatively low most of the time, but generally exceeded 5 NTU more often than at the upstream tributary sites (likely due to natural conditions). The typical low turbidity values measured in the Project area are not likely to have a substantial adverse effect on salmonids. In addition, there is no indication of macroinvertebrate impairment in the lower Sultan River due to high sediment load; and gravel samples collected in the lower Sultan River did not show evidence of high fine sediment content.	It is likely that the generally higher turbidity values observed at the downstream Sultan River sites is related to non-Project-related watershed processes and responses, such as landslides in the canyon reach of OR-3 and OR-2. The generally higher turbidity in the Sultan River downstream of Spada Lake does not have an obvious Project-related cause, and is explainable by other non-Project-related watershed processes and responses (see Section E.6.2.2.2.4).

	Baseline Environmental Conditions		
Pathway Indicators	Baseline Function	Description	Cause of Degradation from PFC
Chemical Contamination / Nutrients	PFC	Ecology monitors water quality at the mouth of the Sultan River, near Sultan, Washington (Station 07E055). Water quality data have been collected at this site since 1960. The overview of the data for this station provided on Ecology's web site indicates that, "overall water quality at this station met or exceeded expectations and is of lowest concern". No reaches in the Sultan River basin are listed under Section 303(d) of the CWA. Nutrient and chlorophyll-a values observed during monitoring in 2007 and 2008 were consistently low at all river and tributary sites, indicating a low potential for any high (or nuisance) primary production.	No degradation from PFC, as no reaches in the Sultan River basin are listed under Section 303(d) of the CWA.
Habitat Access			
Physical Barriers	NPF	The City's Diversion Dam blocks upstream fish passage at RM 9.7 of the Sultan River. Prior to its construction in 1930, another City Diversion Dam built in 1918 may have blocked Chinook salmon, steelhead, and other fish species access to an additional 6 miles of habitat upstream from this site.	The City's Diversion Dam is a man-made barrier located at RM 9.7 of the Sultan River.
Habitat Elements			
Substrate	PFC	Although Spada Lake intercepts gravel from the upper basin and the frequency and magnitude of high flow events in the Sultan River have been reduced as a result of Project operations, previous and ongoing monitoring activities have shown that both gravel quantity and quality are being maintained in the river below the Diversion Dam, probably through recruitment of sediment in the canyon reach (R2 Resource Consultants 2006; Snohomish County PUD and the City of Everett 2005).	No degradation from PFC. Historical operations of the Project do not appear to have caused the quality of the spawning gravels to decline (R2 Resource Consultants 2006).
Large Woody Debris (LWD)	NPF	Wood loading in the Sultan River is modestly lower than the median of western Washington rivers (particularly in the alluvial reach) and much of the LWD is small to medium in size and	Most of the riparian forest along the lower Sultan River is composed of mid-successional forest stands, with an overall low percentage of mature and old

	Baseline Environmental Conditions		
Pathway Indicators	Baseline Function	Description	Cause of Degradation from PFC
		positioned along the channel margins. Consequently, its role in forming habitats, especially pool habitats is very limited (Stillwater Sciences and Meridian Environmental, Inc. 2008). Overall LWD density (including LWD jams) is 196 pieces per mile in OR-2, 102 pieces per mile in OR-3, and 80 pieces per mile in OR-1; however, very few of the individual LWD pieces (only 15 percent) were greater than 24 inches in diameter.	growth stands (Stillwater Sciences and Meridian Environmental, Inc. 2008). The size of trees available for LWD recruitment is limited by active forest management, and the low abundance of very large trees that could serve as major LWD anchors. The current lack of large legacy wood pieces within the channel is probably a consequence of the common practice of actively removing LWD from streams which occurred several decades ago (Stillwater Sciences and Meridian Environmental, Inc. 2008b).
Pool Frequency and Quality	NPF (OR-1) PFC (OR-2 and OR-3)	Aquatic habitat within OR-3 is mostly pool and glide habitat types (65 percent). Most of the pool habitat units (38 of 45) are controlled by bedrock formations. Aquatic habitat within OR-2 is characterized by frequent main channel pools (45.9 percent) separated by numerous low gradient riffles (22.7 percent). More than two-thirds (43 of 60) of the pool habitat units in OR-2 are controlled by bedrock and boulder substrates. Aquatic habitat within OR-1 is comprised mostly of glide (51.7 percent) and low gradient riffle types (28.4 percent).	The low volume of LWD in the alluvial reach has likely decreased the channel's overall physical heterogeneity (i.e., reduced pool frequency). Pool formation and spacing upstream of the alluvial reach is set by the frequency of rock avalanche deposits. The size of trees available for LWD recruitment is limited by active forest management, and the low abundance of very large trees that could serve as major LWD anchors.
Off-Channel Habitat/Refugia	NPF (OR-1) PFC (OR-2 and OR-3)	All side channel habitat in the Sultan River is located within OR-1, an unconfined alluvial floodplain downstream of RM 3.3 (Stillwater Sciences and Meridian Environmental, Inc. 2008a). The confined channel upstream of OR-1 precludes the formation of side channels. Off channel habitats in the Sultan River are largely relict features, a consequence of reduced peak flows and vegetation encroachment into formerly active channels. The total length of side channel habitat in the Sultan River is approximately 0.9 miles and accounts for 4.7 percent of the length of all riverine habitat surveyed. Some off-channel habitat in the lower 3 miles of the Sultan River is periodically disconnected from the river (R2 Resource Consultants 2008b). Instream flow surveys indicate that the upstream ends of three	Floodplain and side channel habitats are naturally limited upstream of RM 3.3 due to local geology (i.e., most of the river channel is deeply incised in bedrock). Downstream of RM 3.3, the active channel has decreased in width as a result of reduced frequency and magnitude of peak flows resulting from the Project (Stillwater Sciences and Meridian Environmental, Inc. 2008). Encroachment of riparian vegetation suggests that side channels may be diminishing during Stage II.

	Baseline Environmental Conditions		
Pathway Indicators	Baseline Function	Description	Cause of Degradation from PFC
		side channels in the lower Sultan River become disconnected from the Sultan River at flows of < 200 cfs for Side Channel 3, < 300 cfs for Side Channel 2, and < 375 cfs (approximately) for Side Channel 1 (R2 Resource Consultants 2008b).	
Channel Conditions and Dynamics			
Streambank Condition	AR	Although quantitative data describing streambank conditions are not available for the Sultan River downstream of Culmback Dam, the streambanks appear to support natural riparian function and are stable in OR-1. Steep natural geology results in natural landslide events in the canyon reach in OR-2 and OR-3. However, some of the lower river (in Sultan) has some bank armoring and development.	Most of the river is inaccessible; however, banks along the lower Sultan River have been armored to some degree within the City of Sultan.
Floodplain Connectivity	NPF	Off channel habitats in the Sultan River are largely relict features, a consequence of reduced peak flows and vegetation encroachment into formerly active channels within the floodplain.	Project operations have reduced peak flows (flooding events) in the Sultan River, altering the formation and maintenance of off-channel habitat within the Sultan River floodplain. Near the mouth, the shoreline has also been mildly affected by residential development and bank hardening by property owners, including bank armoring and floodplain confinement upstream of Sportsmen's Park in Sultan. Less than 10 percent of the entire shoreline is hardened.
Flow/Hydrology			
Change in Peak/Base Flow	NPF	Although the mean annual discharge in the Sultan River under Stage II is essentially the same as that observed under Stage I, current operations alter seasonal runoff attributes relative to an undisturbed watershed of similar size, geology, and geography. In general, summer base flows are higher, and fall and winter peak flows are lower, but are longer in duration.	The Spada Lake rule curves are shaped to minimize spill (uncontrolled release of water via the spillway) and provide storage of spring runoff for municipal water supply and instream flow augmentation later in the year during the driest months. This strategy provides significant incidental floodwater storage.
Change in River Stage (Ramping)	AR	Project related down ramping events have the potential to adversely affect anadromous fish in the Sultan River downstream of Culmback Dam. To protect aquatic resources	Surface flows in the lower Sultan River are manipulated by Project operations. These flow fluctuations (i.e., ramping events) have the potential to

	Baseline Environmental Conditions		
Pathway Indicators	Baseline Function	Description	Cause of Degradation from PFC
		(i.e., minimize the potential for stranding), the District has implemented a downramping regime that varies from 1 to 6 inches per hour, depending on the affected river reach, season, time of day, and river stage. Because the Project is not operated on a "load-following basis", discharges to the river do not fluctuate frequently on a daily basis.	adversely affect ESA listed fish species in the Sultan River downstream of Culmback Dam.
Watershed Conditions			
Road Density and Location	AR	There is a road network in the Sultan River watershed associated with rural development, recreation, timber harvest, and Project access activities. Road densities are unknown.	Development, recreation, timber harvest, and Project access.
Riparian Reserves	NPF	The function of large woody debris recruited from riparian areas along the lower Sultan River is limited because the surrounding forests consist solely of second- and third-growth timber. The lack of large trees within the riparian zone appears to be a significant factor in terms of limiting pool formation in the lower Sultan River.	Timber harvest has occurred throughout the watershed and harvest along the lower Sultan River (specifically) has resulted in a substantial loss of large trees that could be recruited to the river channel.

Notes: NPF = baseline not properly functioning
AR = baseline at risk
PFC = baseline properly functioning condition
Width/depth ratio, increase in drainage network, and disturbance history indicators were not included in this analysis due to a lack of data describing these conditions in the Project area.

E.6.6.2.2 Rare, Threatened and Endangered Plants

E.6.6.2.2.1 Federally Listed Plants

As described in Section E.6.6.1.2, no federally listed plant species are expected to occur in the Project area, and none were detected during special status plant surveys conducted in the Project area in 2007 (Smayda Environmental Associates, Inc. et al. 2008a).

E.6.6.2.2.2 Other Special Status Plants

The District's special status plant surveys (Smayda Environmental Associates, Inc. et al. 2008a) covered 594 acres, including 554 acres of Project lands and 40 acres of NFS lands along the Sultan River downstream of Culmback Dam. During the surveys, botanists recorded 317 vascular plant species and 129 species of lichens and bryophytes (Smayda Environmental Associates, Inc. et al. 2008a). No special status vascular plant species were observed during the survey. One species of lichen designated sensitive by the U.S. Forest Service (*Usnea longissima*) was observed on both NFS and WHMP lands. The lichen is relatively common on the northern half of the Mt. Baker-Snoqualmie National Forest. Three USFS special status lichens (*Cetrelia cetrarioides, Nephroma bellum, and Hypogymnia duplicata*) were observed on WHMP lands. All three sites are located in areas reserved from timber harvest activity; recreational use is limited to walk-in access. No risk to these populations is anticipated based on ongoing Project operations and Project-related recreation activity.

E.6.6.2.3 Rare, Threatened and Endangered Wildlife Species

E.6.6.2.3.1 Federally Listed Wildlife Species

Participants in the scoping process identified two listed species – northern spotted owl and marbled murrelet – as warranting studies to evaluate their status in the Project area and to identify potential Project effects. Studies were not requested for any other listed species, but compliance with ESA requires that federal agencies evaluate potential effects of their actions on all threatened and endangered species that may be present. For this reason, the following sections address Canada lynx, gray wolf, and grizzly bear, as well as summarizing the results of the northern spotted owl and marbled murrelet surveys (Biota Pacific 2008a and 2008b).

<u>Canada Lynx</u>

The Canada lynx is strongly associated with cold, moist forests at elevations over 4,000 feet. The Jackson Project is located at elevations ranging from 146 feet at the Trout Farm Road River Access to 2,492 feet on the upper end of a steep unit of old growth above the South Fork Arm of Spada Lake, and forested areas are dominated by western hemlock rather than spruce, lodgepole, or subalpine fir. There are no records of lynx in the Project area, and given the absence of suitable habitat, it is unlikely that they would be present in the future. For these reasons, Project operations would not affect the Canada lynx.

Gray Wolf

Throughout their range, gray wolves make use of a variety of habitats, from ocean beaches to alpine meadows. Modeling of potential habitat in the Pacific Northwest indicates they are most likely to occur in forested areas with low road densities and abundant deer or elk (Larsen and Ripple 2006). With the success of reintroduced populations in central Idaho and expanding natural populations in Canada, it is likely that gray wolves will begin to re-occupy areas of their former range where they are tolerated. Gray wolves could use habitat in the Williamson Creek and Spada Lake tracts, as well as NFS and DNR lands to the east in the future, although the number and frequency of wolves in the area would be low due to relatively low deer populations. Gray wolves would likely avoid more developed areas west of Spada Lake.

Grizzly Bear

The Jackson Project area provides potential grizzly bear habitat in the Williamson Creek and Spada Lake tracts. Similar conditions exist on DNR and NFS lands to the east. The rest of the Project area, and other low-elevation lands to the west of Spada Lake are not suitable, due to habitat fragmentation, expanding residential development, recreation activity, and vehicle traffic in the vicinity. Transient grizzly bears could occur near Spada Lake and Williamson Creek in the future if populations in the North Cascades Recovery Zone are augmented and/or expand as a result of other recovery actions, but management under the WHMP would neither encourage nor prevent grizzly bear presence in the basin, or negatively affect bears that might occur there.

Northern Spotted Owl

Habitat mapping and field assessment indicated that about 2,881 acres of mature and old-growth forest associated with the Jackson Project could provide suitable habitat for the northern spotted owl and warranted surveying (Biota Pacific 2008a). No spotted owls were detected during subsequent surveys conducted in 2007 and 2008. Barred owls, possible competitors with spotted owls, were detected during the nesting season in all three owl survey areas (Lake Chaplain, Spada Lake, and Williamson Creek). Further evidence that barred owls may be nesting on or near Project lands was provided by the incidental observation of a recently-fledged barred owl along the South Shore Road.

The absence of any spotted owl responses during the surveys indicates that no spotted owls nest on Project lands, and that continued operation of the Project and implementation of forest management activities under the proposed TRMP (Appendix E) would not directly affect spotted owls. There would be some potential for Project operations and Project-related activities to indirectly affect owls that may nest on adjacent lands, although none were detected in close proximity to the Project in 2007 and 2008.

Spotted owls have very large home ranges in the western Cascades of Washington, and are known to forage 1.8 miles or more from their nests in the summer and farther in the winter. Human activity that does not include blasting in the Project area could disturb nesting spotted owls up to 360 feet from the Project, if they are present, while blasting could disturb nesting owls up to 1.0 mile from the Project (USFWS 2003). Modification or removal of suitable spotted owl habitat within the Project area could reduce the amount of habitat available to one or more spotted owls nesting up to 1.8 miles away or dispersing through the Project area outside the nesting season. However, the number of spotted owls currently nesting in the western Cascades is small, so the potential for Project-related impacts is negligible.

The nearest designated critical habitat for northern spotted owls lies approximately 1 mile from the proposed Project boundary in the vicinity of Williamson Creek. Project operations would not affect this area or alter any of the PCEs (described above in Section 6.6.1.3.4) needed to support this species.

Marbled Murrelet

Six areas surveyed in 2007 and 2008 are considered to be occupied by marbled murrelets; five as a result of the surveys and the sixth because it is contiguous with habitat outside the Project area that was found to be occupied in the 1990s. The six occupied areas are Culmback West, Culmback East, Olney Pass, South Fork Spada Inlet, Williamson Creek North and Williamson Creek South. Impacts to marbled murrelets can occur when known or potential nest trees are felled, or when the forest surrounding nest trees is materially altered by the felling of other trees. Project related activities that could require the felling of trees are: (1) danger tree removal along Project roads, (2) wildlife habitat enhancement activities required by the TRMP, and (3) creation of trails and other recreational improvements.

Project roads pass through or along the Culmback East, Olney Pass and South Fork Spada Inlet areas. The felling of roadside danger trees with nest platforms during the nesting season could directly harm nesting marbled murrelets, as they have been known to nest in close proximity to forest roads. Felling of danger trees with nest platforms outside the nesting season would not directly harm marbled murrelets, but could reduce nesting opportunities in subsequent years. The felling of smaller danger trees (without nest platforms) would not reduce the amount of nesting opportunities, but could reduce the quality of nesting habitat by exposing nest trees to wind and nests to predators. Implementation of the Marbled Murrelet Habitat Protection Plan, discussed in Section E.6.6.3.3.1 and detailed in Appendix G would minimize the risk of inadvertent adverse effects on marbled murrelets during forest management and other activities carried out under the TRMP.

The TRMP would require the District to create snags, decaying live trees, logs and forest canopy gaps by felling or topping live trees. None of these TRMP activities would occur within occupied habitat, but such activities near occupied habitat could reduce the potential for marbled murrelet nesting in if they made nest trees more vulnerable to windthrow or predation. Recreational developments in occupied habitat could impact marbled murrelets if they required the felling or topping of potential nest trees or increased human activity in occupied habitat during the nesting season.

Marbled murrelets are not particularly sensitive to established human presence at low to moderate levels, such as occasional vehicle traffic along forest roads, use of hiking trails, and camping at undeveloped sites (Long and Ralph 1998). They may, however, be disturbed by sudden increases in human activity in or near active nests. These impacts can be avoided by scheduling human activities in and near occupied habitat to occur outside the critical nesting season of April 1 through August 31, as defined in Washington Forest Practices Rules (WAC 222-16-010). Disturbance impacts can be reduced during the critical nesting season by keeping human activity to a minimum, particularly during the periods of dawn (1 hour before sunrise to 2 hours after sunrise) and dusk (1 hour before sunset to 1 hour after sunset) when adult marbled murrelets are most active at nests. These measures are further discussed in the Marbled Murrelet Habitat Protection Plan (Appendix G).

Marbled murrelets can also be affected by increases in the numbers of predators (primarily ravens, crows and jays) that often accompany human presence. This potential effect from nest predators could be reduced by enforcing tight controls on food waste and other trash that attracts the predators.

Project operation would not affect designated critical habitat on DNR or NFS lands adjacent to the proposed Project boundary, or any of the PCEs associated with it.

E.6.6.2.3.2 Other Special Status Wildlife Species

Invertebrates

Beller’s ground beetle is the only special status invertebrate likely to occur in the Project vicinity. Because of its association with sphagnum bogs, it may be present in wetlands associated with Lost Lake. Wetlands are protected under the WHMP, and no effects on this species or its habitat would be expected.

Amphibians

Project effects on amphibians are discussed in Section E.6.4.2.2.1. Numerous wetlands throughout the Project area provide habitat for species that breed in ponds or pools along streams, and implementation of wetland and riparian buffers as part of the WHMP would continue to protect these habitats.

Coastal tailed frogs were documented in tributaries to Spada Lake and in the bypass reach below Culmback Dam. Protection of riparian buffers under the WHMP would maintain cool water temperatures in these streams. As discussed in Section E.6.4.2.2.1, Project operations that result in very cold water temperatures at the upper end of the bypass reach (OR-3) during the summer and very warm water temperatures at the lower end near the Diversion Dam could limit habitat suitability for coastal tailed frogs, a species that is associated with a range of temperatures between 9 and 14.2 °C.

Birds

Special status birds that may occur in the Project area are primarily associated with forested habitats, lakes and wetlands. The District’s implementation of the WHMP likely protects and enhances habitat for special status bird species that are associated with mature or old-growth forest, or structural components of such forest, e.g., snags. These species include the northern goshawk, Vaux's swift, olive-sided flycatcher, pileated woodpecker, merlin, and great gray owl. Protection of riparian and wetland buffers also protects habitat for the bald eagle. Routine operations and maintenance, recreation, and forest management activities may cause noise disturbance, but effects are likely minor and temporary.

Project operations are unlikely to affect the golden eagle or peregrine falcon. Although they may hunt in the area, the Project does not contain any suitable nesting habitat for these species.

Spada Lake and Lost Lake may provide resting habitat for migrating western grebes, and may provide some nesting habitat for common loons. In an attempt to attract loons, the District has installed, maintained and monitored nesting platforms, but to date, no loons are known to have used them.

Mammals

The District's implementation of the WHMP likely protects and enhances habitat for special status bats that may be present in the Project area. Forest management activities that focus on protection of existing old-growth and management of younger stands to promote old-growth characteristics would help to provide cover and forage.

E.6.6.3 Proposed Environmental Measures

E.6.6.3.1 Rare, Threatened and Endangered Fish

Although naturally produced Chinook salmon spawner abundance is increasing under current Project operations, the District proposes to implement several PM&Es to further enhance aquatic resources in the lower Sultan River. These measures are intended to benefit Chinook, steelhead and bull trout, as well as the overall aquatic community. Important components of PM&E measures that would benefit Chinook, steelhead and bull trout include:

- Establishing and convening an ARC to provide a consultation mechanism for implementation of aquatic resources license articles pertaining to aquatic resources.
- Modifying the specified minimum flows in the Sultan River below the Diversion Dam and Powerhouse to protect, mitigate, and enhance fish and wildlife resources, riparian vegetation, aesthetic resources, and water quality.
- Modifying Spada Lake reservoir rule curves in part to provide higher minimum flow requirements, while reducing the risk of spill following Chinook fall spawning and steelhead spring spawning.
- Developing and implementing a plan to provide a water budget of 22,000 acre-feet total over the 50-year license term to provide controlled flows, supplement natural accretion flows, and support geomorphic and channel maintenance flow (collectively referred to as process flows).

- Modifying and refining the Project downramping rate schedules and formalize downramping frequency limitations to improve Project operation and minimize the risk of fish stranding.

- Installing a governor control system to bypass the Pelton turbine needle valve for releases to the Sultan River. This measure is expected to greatly reduce the potential for an immediate reduction in Sultan River flow caused by inadvertent turbine or generator shutdown to further reduce redd dewatering and stranding potential.

- Controlling maximum flow during salmon spawning to reduce subsequent redd dewatering potential during the incubation period, and attempt to keep redds covered with water until fry emergence has occurred.

- Developing and implementing a plan to comply and monitor compliance with Washington State water quality standards in the Sultan River designed to promote the persistence of listed fish species.

- Developing and implementing a plan to install up to five LWD structures in the lower Sultan River to improve main channel habitat complexity and up to three LWD structures to improve mainstem/side channel connectivity.

- Developing and implementing a plan to provide a minimum of 10,000 linear feet (creating 3 acres) of salmonid rearing habitat at a minimum of five side channel sites in the lower Sultan River.

- Continuing to monitor steelhead trout and Chinook, pink, and chum salmon annual escapement in the Sultan River to provide timely data for fishery managers to make informed decisions.

- Providing pulsed flows, from the Powerhouse, for juvenile outmigration and adult upstream migration.

- Continuing to operate the Project in a manner designed to maintain water temperatures within the pre-Stage II range downstream of the Diversion Dam.

E.6.6.3.1.1 Effects of the Proposed Action on Rare, Threatened and Endangered Fish

The effects of the proposed action on listed fish species in the Project area are presented following the NMFS method (NMFS 1996) to assess Project effects for consultation under Section 7 of the Endangered Species Act. As bull trout are only transitory within the lower Sultan River, assessment of Project effects using the NMFS (1996) method should also apply to bull trout, because their requirements for migration and foraging are similar to Chinook.

Under the ESA, effects of the proposed action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR § 402.02). Direct effects occur at the Project site and may extend upstream or downstream based on the potential for impairing important habitat elements. Indirect effects are defined in 50 CFR § 402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification" (50 CFR § 403.02). "Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR § 402.02).

NMFS may use either or both of two independent techniques in determining whether the proposed action jeopardizes a species' continued existence. First, NMFS may consider the impact in terms of how many listed fish will be killed or injured during a particular life stage, and then gauge the effects of that take on population size and viability. Alternatively, NMFS may consider the effect on the species freshwater habitat requirements, such as water temperature, stream flow, etc. The habitat analysis is based on the well-documented cause and effect relationships between habitat quality and population viability. While the habitat approach to the jeopardy analysis does not quantify the number of fish adversely affected by habitat alteration, it considers this connection between habitat and fish populations by evaluating existing habitat condition in light of conditions and functions known to be conducive to salmonid conservation (Spence et al. 1996). In other words, it analyzes the effect of the action on habitat functions that are important to meet salmonid life cycle needs. The habitat approach then links any failure to provide habitat function to an effect on the population and to the ESU as a whole. For this consultation, the following analysis relies on the habitat approach. The effects are summarized with respect to whether they impair properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of the impaired habitat toward PFC.

Direct Effects of the Proposed Action

Direct effects are the direct or immediate effects of the proposed Project on a listed species or its habitat. Under existing conditions, the primary factors limiting ESA listed salmonids in the lower Sultan River result from modifying the river's natural flow regime (as summarized in Table E.6.6-1 of the Environmental Baseline description). This modified flow regime has:

- Reduced the Sultan River main channel habitat area (negative effect)
- Reduced side and off-channel habitat area (negative effect)
- Reduced overall habitat complexity (negative effect)

Altered water temperature regimes (positive effect in OR-1 and OR-2, negative effect in OR-3 although listed fish do not have access to this reach due to the City's Diversion Dam)

The District proposes several PM&Es to mitigate these impacts (see Section E.6.6.3.1).

While "take" of ESA listed fish species has not been documented in the lower Sultan River under existing Project operations, the District proposes to implement additional measures to further reduce the potential for Chinook redd dewatering, Chinook and steelhead stranding (during Project downramping), and Chinook and steelhead redd scour (due to spill).

As presented in Section E.6.3.3.13, implementing the proposed cap on flows during the Chinook salmon spawning period along with monitoring of spawning locations would minimize the potential for redd dewatering due to Project operations. Modifying the Project ramping rate requirements and installing the Pelton unit flow continuation system would further reduce juvenile Chinook and steelhead stranding potential compared to existing operations (see Sections E.6.3.3.4 and E.6.3.3.5). These proposed measures would also benefit bull trout, although only larger bull trout are expected to use the lower Sultan River for foraging habitat. Fish of such size are not expected to be stranded under existing Project ramping requirements, and would not likely be stranded under the more restrictive proposed ramping requirements.

As discussed in Section E.6.3.3.12, the District proposes to modify the reservoir operational rule curves to provide a balance of reliable municipal water supply, increased minimum stream flows, incidental winter flood storage, higher lake levels for early summer recreation and to prevent or reduce risk of spill following Chinook fall spawning and steelhead spring spawning. The analysis in Section E.6.2.3.2.8 indicates that proposed operations would result in similar or less disruption (by reducing average spill magnitude) of Chinook salmon spawning than occurs under existing conditions (which is relatively rare).

Although no specific impacts on downstream or upstream migrating Chinook, steelhead, or bull trout have been identified as a result of Project flow alternations, the District proposes to provide pulsed flows from the Powerhouse for juvenile outmigration and adult upstream migration. As presented in Section E.6.3.3.11, proposed pulsed flows may increase juvenile steelhead and Chinook outmigrant survival, and aid in upstream adult migration of Chinook. The effects of such flows would either be beneficial or benign. Negative effects on listed fish are not expected to occur due to the short duration and magnitude of proposed pulsed flows.

Indirect Effects of the Proposed Action

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action. One potential indirect effect of the proposed action on listed species has been identified, and is associated with the continued funding of the WDFW administered steelhead planting program.

Hatchery practices and fishery management have the potential to affect the listed fish species. Planting hatchery stocks can negatively affect listed species by increasing competition for food, hybridization, loss of genetic fitness, and increased predation on listed species. Impacts to all listed species resulting from hatchery operations funded by the District, but carried out by WDFW, are being addressed through separate consultations during the development and evaluation of specific Hatchery Genetic Management Plans and through NMFS' ongoing NEPA evaluation of Puget Sound hatchery programs.

The District proposes to continue to monitor steelhead trout and Chinook, pink, and chum salmon annual escapement in the Sultan River. These data would be provided in a timely manner to fishery managers for use in making informed fishery management decisions in the Sultan River, which also aids in Snohomish Basin management as a whole. Providing timely and accurate data is considered a positive indirect effect of the District's proposed fish monitoring PM&E.

Effects of Interdependent and Interrelated Actions

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification (50 CFR 402.02). Interdependent actions are those that have no independent utility apart from the action under consideration (50 C.F.R. 402.02). In other words, if any other actions would be implemented only as a result of implementing the proposed action, they would be analyzed in this section. No interdependent or interrelated projects or actions have been identified in association with proposed Project operations.

Effects of the Proposed Action on the Environmental Baseline

As discussed in Section E.6.6.2.1, the PFC framework of baseline environmental conditions is described as "properly functioning," "at risk," or "not properly functioning." If a proposed action is likely to impair properly functioning habitat (Impair), appreciably reduce the functioning of already impaired habitat (Reduce), or retard the long-term progress of impaired habitat toward PFC (Retard), it is usually found to be likely to jeopardize the continued existence of the species, or adversely modify its critical habitat, or both, depending on the specific consideration of the analysis. Such considerations may include, for example, the species' status, the condition of the environmental baseline, the particular reasons for listing the species, any new threats that have arisen since listing, and the quality of available information. Actions which do not compromise a species' biological requirements to the degree that appreciably reduces the species' viability and chances of survival in the action area are considered not to reduce or retard (NR). The effect of the proposed action on baseline environmental conditions (summarized from Table E.6.6-2) is presented in Table E.6.6-3.

Table E.6.6-3 Analysis of the proposed action on the environmental baseline.

	Baseline Environmental Conditions		
Pathway Indicators	Baseline Function	Description	Effect of Proposed Action
Water Quality			
Temperature	AR (OR-1 and OR-2) NPF (OR-3)	Proposed action would continue to beneficially condition water temperature in OR-1 and OR-2, which is cooler on average than pre-Project conditions and work to eliminate the rare exceedences of state water quality standards. In addition, water temperature would be conditioned in OR-3 to provide more favorable fish growth conditions, which would benefit resident fisheries and macroinvertebrates .	NR, and would improve
Sediment/Turbidity	AR	The generally higher turbidity in the Sultan River downstream of Spada Lake does not have an obvious Project-related cause, and is explainable by other non-Project-related watershed processes and responses (see Section E.6.2.2.2.4). The Proposed Action would not further increased turbidity.	NR
Chemical Contamination /Nutrients	PFC	Spill prevention plans would be in place to minimize and avoid contamination in the future.	NR
Habitat Access			
Physical Barriers	NPF	The City's Diversion Dam blocks access of listed fish to OR-3	NR
Habitat Elements			
Substrate	PFC	Under existing conditions, spawning gravel quality and quantity are being maintained downstream of Culmback Dam, most likely due to recruitment of sediment in the canyon reach, which is expected to continue under the proposed action.	NR
Large Woody Debris	NPF	Under proposed action, LWD would be installed in the lower Sultan River and stockpiled for other entities to use for LWD projects. In addition, implementing process flows would likely aid in mobilizing natural LWD.	NR, would improve

	Baseline Environmental Conditions		
Pathway Indicators	Baseline Function	Description	Effect of Proposed Action
Pool Frequency and Quality	NPF (OR-1) PFC (OR-2 and OR-3)	Habitat enhancement measures under the proposed action would improve LWD occurrence, and may improve the condition of pool frequency and quality. Because such improvements cannot be quantified at this time, this analysis makes a conservative assumption that the proposed action would not appreciably change pool conditions.	NR, but may improve.
Off-Channel Habitat	NPF (OR-1) PFC (OR-2 and OR-3)	Habitat enhancement measures under the proposed action would improve access and flow condition of off-channel habitat.	NR, would improve
Channel Conditions and Dynamics			
Streambank Condition	AR	Side channel enhancement and LWD projects may improve streambank conditions in localized areas. Process flows may scour stream banks, but such flows are considered natural habitat processes and beneficial to listed fish species habitat, and may create beneficial undercut banks and other complex bank oriented habitat.	NR, may improve
Floodplain Connectivity	NPF	Side channel enhancement in combination with process flow events would increase connectivity to the floodplain compared to existing conditions. Project operations would continue to reduce large flood events and flooding downstream, such as within the City of Sultan.	Improve over existing conditions
Flow/Hydrology			
Change in Peak Flow	NPF	Project operations would continue to reduce peak flows, which benefits listed fish species by reducing redd scour.	Would be beneficial overall to listed fish species in combination with all other proposed habitat PM&Es
Change in Base Flow	AR	Under the proposed action, minimum flow requirements would be higher overall than under existing conditions, would increase Chinook spawning and rearing habitat, and provide about the same steelhead spawning and rearing habitat. In conjunction with increases in side channel habitat, overall spawning and rearing habitat area for listed fish species would increase.	NR, would improve

	Baseline Environmental Conditions		
Pathway Indicators	Baseline Function	Description	Effect of Proposed Action
Change in River Stage (Ramping)	AR	Proposed ramping rates would be more stringent than occur under existing conditions, which would further reduce stranding potential for juvenile listed fish species compared to existing conditions (which is thought to be negligible)	NR, would improve
Watershed Conditions			
Road Density and Location	AR	Portions of the South Shore Road would be decommissioned by the DNR and no new roads would be added under the proposed action. However, due to the distance from listed fish habitat, there is likely to be no effect (positive or negative) on listed fish.	NR
Riparian Reserves	NPF	The Project would have no influence on riparian reserves in the Sultan River basin.	NR

Notes:
- IMPAIR = impair properly functioning habitat
- REDUCE = appreciably reduce the functioning of already impaired habitat
- RETARD = the long-term progress of impaired habitat towards properly functioning condition
- NR = not reduce, retard, or impair
- NPF = baseline not properly functioning
- AR = baseline at risk
- PFC = baseline properly functioning condition.

Effects of the Proposed Action on Critical Habitat Primary Constituent Elements

The Sultan River is designated critical habitat for Chinook salmon from the mouth of confluence of the Sultan River with the Skykomish River upstream to the City's Diversion Dam. Critical habitat is not designated for steelhead, nor is the Sultan River designated as critical habitat under the final Coastal/Puget Sound bull trout critical habitat rule.

This section analyzes the effect of the proposed action on Chinook salmon designated critical habitat. NMFS determines the effect on critical habitat through an analysis of critical habitat PCEs. PCEs are physical or biological features that are essential for the species to complete each life stage and are essential to its conservation. In the final critical habitat designation for Puget Sound Chinook salmon, NMFS developed a list of PCEs based on Chinook salmon and steelhead unique life history needs. As the PCEs developed by NMFS are applicable to steelhead, this analysis would serve to determine Project effects on critical habitat for Puget Sound steelhead should such be designated before the Project relicensing process is concluded.

Three primary freshwater habitat elements are essential to the conservation of salmon and steelhead. These are properly functioning spawning, rearing, and migration corridor habitats. As stated in the final critical habitat rule for Puget Sound Chinook salmon, the "Matrix of Pathways and Indicators" (Matrix) (NMFS 1996) guided the identification of the salmon and steelhead PCEs. The Matrix describes general characteristics of most of the essential habitat features that are important for salmon and steelhead spawning, rearing, and migration. Several habitat indicators from the Matrix can be applied to each PCE. The most important indicators governing properly functioning conditions for each PCE (recognizing that all habitat indictors are related to some degree and important to all three PCEs) are listed in the table below (Table E.6.6-4).

Table E.6.6-4 Chinook salmon critical habitat PCEs in relation to NMFS matrix habitat condition indicators.

Primary Freshwater Habitat Elements	Constituents
Spawning Habitat	Water Temperature Chemical Contamination/Nutrients Sediment/Turbidity Substrate Peak/Baseflow
Rearing Habitat	Water Temperature Water Quality/Nutrients Large Woody Debris Pool Frequency and Quality Off-channel Habitat Stream bank Condition Chemical Contamination/Nutrients Riparian Reserves Road Density and Location
Migration Corridor	Water Temperature Physical Barriers Peak/Base Flow

The proposed action would have the following effects on Chinook salmon critical habitat PCEs:

Spawning PCE

The Spawning PCE would improve under the proposed action because the Project would continue to provide beneficial water temperature conditioning in OR-1 and OR-2. The overall Chinook spawning habitat WUA would increase by about 12 percent compared to existing conditions. In addition, modeling suggests that spill events would continue to be limited, reducing redd scour potential. Ample gravel currently exists to support an increasing naturally produced Chinook population in the Sultan River. Such gravel quantity and quality is expected to be maintained over the long term, as overall gravel recruitment to OR-1 and OR-2 is not influenced by the Project.

Rearing PCE

The Rearing PCE would improve under the proposed action by increasing minimum flows, providing access to side channels, installing LWD, providing beneficial water temperature control in OR-1 and OR-2, and implementing more restrictive ramping rates.

Migration Corridor PCE

The Migration Corridor PCE would be improved by increasing minimum stream flow requirements, providing pulsed flows for adult upstream migration, and by providing beneficial water temperature control in OR-1 and OR-2.

The proposed action would "not retard" or would improve the conditions for all of the Matrix habitat indicators as listed in Table E.6.6-2. However, the Project would continue to "impair" the peak flow and floodplain connectivity indicators (although the floodplain connectivity indicator would improve compared to existing conditions). Through habitat enhancement (i.e., side channels and LWD) and implementation of process flows in combination with the beneficial effects of reduce peak flows (i.e., reduced redd scour), habitat conditions are expected to fully support and improve Chinook salmon spawning and rearing habitat conditions over the long term. These habitat conditions are expected to support a continued increasing trend in naturally produced Chinook salmon spawner escapement in the Sultan River, as has occurred over the last decade under existing Project operations. As the proposed action would support and improve overall Chinook salmon freshwater PCEs, the proposed action would not destroy or adversely modify Chinook salmon designated critical habitat in the Sultan River.

E.6.6.3.2 Rare, Threatened and Endangered Plants

E.6.6.3.2.1 Federally Listed Plants

No federally listed plant species are expected to occur in the Project area, and none were detected during field surveys.

E.6.6.3.2.2 Other Special Status Plants

Based on the results of special status plant surveys conducted in the Project area in 2007, no rare, threatened or endangered species are present and none would be affected by on-going Project operation, or by implementation of any PM&Es. Four species of special status lichen were observed; no risk to these populations is anticipated based on ongoing Project operations and Project-related recreation activity. For this reason, the District is not proposing any specific measures for management of special status plants.

E.6.6.3.3 Rare, Threatened and Endangered Wildlife Species

E.6.6.3.3.1 Federally Listed Wildlife Species

Canada Lynx

As discussed in Section E.6.6.3.2, the Canada lynx is not expected to occur in the Project area. Proposed Project operations would not affect this species.

Gray Wolf

Gray wolves are not known to be present in the Project vicinity at the current time. Gray wolves may occur in the future, as populations in British Columbia and Idaho expand. Implementation of the proposed TRMP, which would focus on the protection and enhancement of old-growth and mature stands in the Williamson Creek and Spada Lake tracts, would provide secluded denning areas. The management of second growth forest to accelerate old-growth development could reduce black-tailed deer (wolf prey) numbers at Spada Lake and Williamson Creek in the short to mid-term, but would eventually increase deer numbers and have a positive effect on wolves in the long term.

Grizzly Bear

Grizzly bears are not known to be present in the Project vicinity at the current time, and due to extremely low numbers in the North Cascades Recovery Zone, it is unlikely that they would occur in the Project vicinity in the future. However, implementation of the TRMP, including forest management activities and protection of wetland and riparian buffers, would protect suitable habitat for the grizzly bear in the Spada Lake and Williamson Creek tracts.

Northern Spotted Owl

Issue

No issues concerning northern spotted owls were identified, because completion of protocol-level surveys in the Project area in 2007 and 2008 indicated that no owls are present on Project lands.

Proposed PM&E

The District is not proposing any specific measures for management of northern spotted owls, because none are known to use Project lands. However, implementation of the TRMP may affect northern spotted owls.

Environmental Analysis

Forest management activities conducted under the proposed TRMP could indirectly affect northern spotted owl habitat, if nesting occurs on adjacent lands within 1.8 miles of the Project. Forest management or ground-disturbing activities could cause noise disturbance if nesting is within 360 feet of the proposed activity. If blasting is involved, noise disturbance could occur if nesting birds are located within 1.0 mile of the activity.

To prevent indirect adverse impacts on northern spotted owls, the District would continue to follow Washington Forest Practice Rules for activities conducted under the proposed TRMP such as thinning, patch cuts, and snag creation, as well as for trail construction, and road construction, repair, or closure that may occur. The District would implement "disturbance avoidance" measures if needed.

Over the long term, implementation of the TRMP could improve habitat suitability for northern spotted owls, through protection of old-growth and management of younger stands to accelerate the development of old-growth characteristics. Whether northern spotted owls could ever make use of this habitat is likely to depend, in large part, on interactions with barred owls, which has been identified as a chief concern in meeting regional recovery goals (USFWS 2008a).

Marbled Murrelet

Recent surveys by the District and others have documented the presence of marbled murrelets (a federally-listed threatened species) in the Sultan basin, and have resulted in the designation of forest in and near the Project boundary as "occupied" by nesting marbled murrelets (Biota Pacific 2008b).

Issue

Three general types of Project-related activities have the potential to directly or indirectly affect nesting marbled murrelets and/or their habitat in the basin:

Roadside Danger Trees: An estimated 3 miles of Project roads pass through or along forest that is occupied by marbled murrelets or is contiguous with habitat occupied by marbled murrelets. This number of affected road miles could increase during the term of the new license as forests in and near the Project boundary mature and additional acres become suitable for marbled murrelet nesting, or if the District assumes management responsibility for additional miles of existing DNR roads along the south shore of Spada Lake. Among the routine maintenance activities conducted by the District are the pruning, topping and felling of roadside danger trees (trees capable of falling onto and blocking the road and/or striking passing vehicles). Conducting these activities in forest that is occupied or could be occupied by marbled murrelets has the potential to directly or indirectly impact nesting success. The pruning, topping or felling of trees in which marbled murrelets are present during the nesting season could lead to the injury or death of young birds. Similar activities outside the nesting season could reduce the availability of suitable nest sites in successive seasons. The pruning, topping or felling of other dominant or codominant overstory trees in forest surrounding occupied nesting habitat could expose nest trees to increased wind damage and make individual nests more vulnerable to disturbance and predation.

Snags and Forest Canopy Gaps: The Jackson Project Wildlife Habitat Management Plan (WHMP) approved by the FERC in 1989 requires the District to enhance forest habitat for late-seral wildlife species by creating snags and small openings in the forest. It is anticipated these activities would continue, and possibly increase, under the TRMP. Both activities are currently reviewed and permitted through the Forest Practices Act (FPA) process, which requires the avoidance of impacts to marbled murrelets when operating in occupied habitat. Possible revisions during development of the TRMP could result in increases in the size of trees that are topped to create snags, and increases in the size and frequency of gaps. These changes could increase the potential for damaging marbled murrelet nest trees, make marbled murrelet nest trees more vulnerable to wind, make marbled murrelet nests more vulnerable to predators, and disturb or disrupt actively nesting marbled murrelets.

New Recreation Trails and Associated Facilities: At the request of stakeholders, the District is considering the creation of a new foot trail and associated trailhead facilities (picnic sites, restrooms and parking) to improve public access to the upper Sultan River and to the north side of Spada Lake. The trail and associated facilities could be in occupied marbled murrelet habitat. If creation of the trail and/or associated facilities requires the felling of large trees, such felling could eliminate existing marbled murrelet nest trees, reduce the number of potential future nest trees, make remaining trees more vulnerable to wind damage and predation, and disrupt actively nesting marbled murrelets. Increased human activity along the trail or at the trailhead/picnic area could disrupt actively nesting marbled murrelets or make them more vulnerable to predation.

Proposed PM&E

To address potential Project effects on this species and its habitat, the District proposes to implement a MMHPP, as detailed in Appendix G, with the following elements.

1. Occupied Habitat

    1.1. The District will prepare and maintain maps of the Project lands and adjacent areas showing suitable marbled murrelet habitat, occupied marbled murrelet habitat, and other forest within 300 feet of suitable and occupied marbled murrelet habitat. For mapping purposes, suitable and occupied marbled murrelet habitats will be defined according to Washington Forest Practices Rules. At intervals of 10 years or less, the District will update the maps to reflect current habitat conditions. The District may conduct surveys for nesting marbled murrelets in all suitable habitat that is not known to be occupied and has not been surveyed for 10 or more years. If the District chooses not to survey suitable habitat, such habitat would be considered occupied for purposes of this PME. Hereafter in this PME, all references to occupied habitat include suitable habitat that has not been surveyed for 10 or more years. Surveys will be conducted according to the current protocol of the Pacific Seabird Group, or another protocol endorsed by the USFWS and WDFW.

2. Roadside Danger Trees in or within 300 feet of Occupied Habitat

2.1. Prior to the scheduled pruning, topping or felling of roadside danger trees in occupied marbled murrelet habitat, District biologists will evaluate each tree proposed for such activity.

2.2. The District will not prune, top or fell roadside danger trees in occupied habitat that contain marbled murrelet nesting platforms (as defined in Washington Forest Practice Rules), unless the roadside danger tree poses an imminent threat to the operation of the Project or safe use of a Project road. A roadside danger tree will be considered an imminent threat if it is leaning toward a road at an angle of greater than 20 degrees from vertical, is upslope from a road and being undercut by erosion, or is otherwise in a condition that would lead a professional forester or other similarly qualified person to conclude it has a reasonable potential to fall on or across the road without warning.

2.3. The District will not prune, top or fell roadside danger trees in or within 300 feet of occupied habitat during the critical marbled murrelet nesting season (April 1 through August 31), unless the roadside dangers tree poses an imminent threat to the operation of the Project or safe use of a Project road, as described in Section 2.2.

2.4. Outside the critical marbled murrelet nesting season and regardless of imminent threat to the operation of the Project or safe use of a Project road, the District may prune, top or fell roadside danger trees in or within 300 feet of occupied habitat that do not contain marbled murrelet nesting platforms.

3. Snags, Decaying Live Trees, Coarse Woody Debris and Forest Canopy Gaps

3.1. No thinning, snag creation, decaying live tree creation, coarse woody debris creation or gap creation will occur within occupied marbled murrelet habitat.

3.2. Thinning, snag creation, decaying live tree creation, coarse woody debris creation and gap creation may occur within 300 feet of occupied marbled murrelet habitat, provided that:

a. The activity must result in a residual stand density of at least 75 trees per acre greater than 6 inches dbh, of which at least 25 trees per acre are greater than 12 inches dbh and at least 5 trees per acre are greater than 20 inches dbh.

b. No live coniferous trees with marbled murrelet nesting platforms (as defined in Washington Forest Practices Rules), live coniferous trees with a dbh of 32 inches or greater, or other live dominant or codominant trees within 100 feet of either of these two types of trees, may be modified or felled, except that live western redcedar and Pacific silver fir of any size may be modified to create snags or decaying live trees at a density of up to one per 20 acres per decade.

c. No activity may be conducted during the critical marbled murrelet nesting season.

3.3. No thinning, snag creation, decaying live tree creation, coarse woody debris creation or gap creation will be conducted within 0.25 mile of occupied marbled murrelet habitat during the daily peak activity period (one hour before official sunrise to two hours after official sunrise, and one hour before official sunset to one hour after official sunset) in the critical marbled murrelet nesting season.

4. New Recreation Trails and Associated Facilities

4.1. In or within 300 feet of occupied marbled murrelet habitat, the District will lay out trails and associated facilities to minimize the total area of trail and/or facility within 100 feet of potential nest trees (coniferous trees with marbled murrelet nesting platforms), while giving due consideration to other potential environmental and safety considerations.

4.2. In or within 300 feet of occupied marbled murrelet habitat, the District will not fell coniferous trees with marbled murrelet nesting platforms, or live dominant or codominant trees directly adjacent to coniferous trees with platforms, to create a new recreation trail or associated facilities, unless doing so is necessary to make the trail or associated facilities safe, keep the overall area of site disturbance to a reasonable level, and/or avoid impacting slope stability, surface erosion or water quality. If the District determines that the felling of such trees is necessary, the District will fell such trees outside the critical marbled murrelet nesting season (April 1 through August 31).

4.3. The District will provide wildlife-resistant containers for human refuse during trail and associated facility construction and use, and will empty as needed to prevent wildlife access to refuse. The District will post signs alerting users of the need to contain all refuse.

4.4. The District will not conduct the following activities within the specified threshold distances of occupied marbled murrelet habitat during the daily peak activity period (1 hour before official sunrise to 2 hours after official sunrise, and 1 hour before official sunset to 1 hour after official sunset) in the critical marbled murrelet nesting season.

Activity	Threshold Distance[1]
Blast > 2 pounds	1.0 mile
Blast ≤ 2 pounds	120 yards
Impact pile driver, jackhammer, rock drill	60 yards
Helicopter, single-engine airplane	120 yards
Chainsaw	45 yards
Heavy equipment	35 yards

[1] Threshold distances are based on USFWS 2003.

Environmental Analysis

Overall, implementation of the on-going WHMP and proposed TRMP would benefit marbled murrelets by protecting existing late-successional forest and managing younger stands to promote the development of old-growth characteristics. However, some forest management activities would pose a risk of habitat alteration or disturbance. Implementation of the MMHPP would provide a systematic approach to planning and scheduling forest management and other activities (e.g., road maintenance, trail construction) to prevent adverse effects. Preparation of maps showing existing suitable and occupied habitat would be updated every 10 years, at a minimum; this would help to ensure that habitat information is current throughout the new license period.

E.6.6.3.3.2 Other Special Status Wildlife Species

Issue

No issues concerning non-federally listed special status wildlife species were identified.

Proposed PM&E

The District is not proposing to implement any PM&Es specifically targeting special status wildlife that are not also federally listed, but implementation of the TRMP and some fisheries-related PM&Es may benefit this group of animals, as well as those that are protected under the ESA.

Environmental Analysis

Invertebrates

Wetlands would continue to be protected under the TRMP. For this reason, effects on potential habitat for Beller's ground beetle would be the same as under current conditions.

Amphibians

Wetlands and riparian habitat would continue to be protected under the TRMP, and Project effects on western toad and Cascades frog would be the same as under current conditions. It is possible that additional wetland and backwater habitat would be created as a result of the District's proposal to enhance side channels in the lower Sultan River.

As discussed in Section E.6.4.2.2.1, the District proposes to implement a temperature conditioning program to help provide warmer water temperatures in the upper end of the bypass reach (OR-3) during the summer, and cooler water temperatures near the Diversion Dam. This proposal could benefit coastal tailed frogs in OR-3.

Birds

The proposed action would not affect habitat or the prey base for golden eagles or peregrine falcons. Like the WHMP, the TRMP would continue to protect lakes, riparian areas, and wetlands, which could be used by western grebes, common loons and bald eagles. These picivorous species may also benefit as a result of fisheries enhancement measures discussed in E.6.3.3.

Implementation of the TRMP would benefit special status bird species associated with mature and old-growth forest, or those that rely on snag-rich areas in younger stands, by increasing the focus of forest management activities on accelerating the development of old-growth characteristics. Routine operations and maintenance, recreation, and forest management activities may cause noise disturbance, but effects would be minor and temporary.

Mammals

Implementation of the TRMP would provide additional habitat, over time, for special status bats that may be present in the Project area. Like forest-associated birds, special status bats would benefit from forest management activities that increase the area of mature and old-growth forest.

E.6.6.4 Cumulative Effects

E.6.6.4.1 Cumulative Effects on Listed Fish Species

Cumulative effects are defined in 50 CFR § 402.02 as "those effects of future State, tribal, local or private actions, not involving Federal activities, that are reasonably certain to occur in the action area." Future federal actions, including the ongoing operation of hatcheries, fisheries, and land management activities, are not to be considered within the category of cumulative effects for ESA purposes if they require separate consultations pursuant to Section 7 of the ESA, after which they are considered part of the environmental baseline for future Section 7 consultations. The area of cumulative effects analysis for the proposed action is the Project area. Only one action has been identified that is reasonably certain to occur and which is not scheduled to undergo its own Section 7 ESA consultation. This action is increased water withdrawal by the City of Everett to meet future water demand. The cumulative effects of increased demand on lower Sultan River habitat occupied by listed fish is presented in Section E.6.3.4.

Under the proposed action, as City water demand increases, Chinook and steelhead spawning and rearing habitat would decrease. With a future demand of 192 mgd (projected demand beyond the term of a new license), the amount of Chinook spawning and rearing habitat area would be about the same or slightly more than occurs under existing conditions. However, as demand increases, modeling indicates that the reservoir would be more frequently drawn down below elevation 1,380 feet during the fall, which is the Chinook salmon spawning period. This would result in release of unnaturally cold water during the Chinook spawning and early incubation period, which could lower egg survival, delay emergence, and affect juvenile Chinook survival.

E.6.6.4.2 Cumulative Effects on Listed Plant Species

Based on the pre-field review of literature, no listed plant species are expected to occur in the Project area and none were observed during focused surveys of the Project area. For this reason, relicensing of the Jackson Project as proposed would not contribute to cumulative effects on listed plant species.

E.6.6.4.3 Cumulative Effects on Listed Wildlife Species

The only federally listed wildlife species that is currently known to occur within the proposed Project boundary is the marbled murrelet. Northern spotted owls could be present from time to time as transients, but were not documented during field surveys, and their numbers in the North Cascades are thought to be very low (Lint 2005). Both species are strongly associated with late successional forest, and cumulative effects on mature and old-growth habitat would in turn cumulatively affect marbled murrelets and northern spotted owls.

As discussed in Section E.6.4.4, the primary factor affecting old-growth in the Sultan River basin is timber harvest. Timber harvest began in the late 1800s and resulted in the loss of large areas of old-growth conifer forest prior to construction of Phase I of Culmback Dam in 1965. Timber harvest in Washington since 1965 has varied in response to economic pressures and environmental restrictions, but has generally dropped from year to year since the late 1980s. Most remaining old-growth forest in the Sultan River basin is on National Forest System lands managed by the USFS and state lands managed by the DNR. The remaining old-growth forest is generally protected from harvest under the current management policies of both agencies.

Operation of the Jackson Project would positively affect habitat for marbled murrelets and potential habitat for northern spotted owls over the long term through implementation of the TRMP (Appendix E), which would protect existing old-growth and promote the development of old-growth characteristics in younger stands. Implementation of the TRMP would also contribute to cumulative benefits that are expected to result from DNR's management of the Morning Star NRCA and Forest Service management of LSRs in the Sultan River basin, as discussed in Section E.6.4.4.

In addition to the TRMP, the District proposes to implement specific measures identified in the Marbled Murrelet Habitat Protection Plan (Appendix G) to prevent inadvertent loss of nest trees, avoid indirect effects on predator abundance, and minimize the risk of disturbance to nesting birds. To protect spotted owls, if they are present in the future, the District would implement "disturbance avoidance" measures. The District's proposals would be consistent with federal recovery plans for marbled murrelet and northern spotted owl, and would also contribute to cumulative benefits over the long term.

E.6.6.5 Determination of Effects on Listed Species and Critical Habitat

The primary objective of this section is to determine the effects that the proposed action would have on ESA-listed fish and wildlife species and their habitat. This determination will be used by the NMFS and the USFWS to determine whether the proposed action is likely to jeopardize the continued existence of the listed species or to adversely modify their critical habitats (if applicable). To facilitate and standardize the determination of effects for ESA consultations, the NMFS and the USFWS use the following definitions for listed species:

- **No effect:** This determination is only appropriate "if the proposed action would literally have no effect whatsoever on the species and/or critical habitat, not a small effect or an effect that is unlikely to occur." Furthermore, actions that result in a "beneficial effect" do not qualify as a no-effect determination.

- **May affect, not likely to adversely affect:** The appropriate conclusion when effects on the species or critical habitat are expected to be beneficial, discountable, or insignificant. Beneficial effects have contemporaneous positive effects without any adverse effects on the species or habitat.

- **May affect, likely to adversely affect:** The appropriate conclusion when there is "more than a negligible potential to have adverse effects on the species or critical habitat." In the event the overall effect of the proposed action is beneficial to the listed species or critical habitat, but may also cause some adverse effects on individuals of the listed species or segments of the critical habitat, then the proposed action "is likely to adversely affect" the listed species or critical habitat.

E.6.6.5.2 Determination of Effects on Listed Fish Species

In tables E.6.6.2 and E.6.6.3 and in Section E.6.6.3.1.1 above, we examine the existing condition of aquatic habitat in the Jackson Project action area and those measures included in the proposed action that would have the potential to affect designated Chinook salmon critical habitat. Based on this analysis we conclude that the proposed action would improve or at least maintain adequate critical habitat PCEs for spawning, rearing, and migration (as needed to support a natural self-sustaining population of Chinook salmon in the lower Sultan River). As the proposed action is expected improve or at least maintain these PCEs in the action area, the proposed action is not likely to adversely affect designated Chinook salmon critical habitat.

While we conclude that the District's proposed PM&E measures are expected to be beneficial to listed Chinook, steelhead, and bull trout and would likely improve or at least maintain designated Chinook salmon critical habitat PCEs, the risk of infrequent and short-term incidental adverse effects on individual fish cannot be entirely avoided. For example, short-term harm or harassment may be caused by future side channel and LWD enhancement construction activities (i.e., the short-term displacement or removal of fish from in-water work areas).

NMFS (1996) indicates the appropriate ESA effects analysis conclusion is "may affect, likely to adversely affect" when there is "more than a negligible potential to have adverse effects on the species or critical habitat." NMFS (1996) further states "In the event the overall effect of the proposed action is beneficial to the listed species or critical habitat, but may also cause some adverse effects on individuals of the listed species or segments of the critical habitat, then the proposed action is likely to adversely affect the listed species or critical habitat".

Although the proposed action of issuing a new Project license would have an overall net benefit on ESA listed fish species compared to existing conditions, following the guidance presented in NMFS (1996), we conclude that the proposed action is "likely to adversely affect" listed Chinook salmon, steelhead, and bull trout.

Based on these determinations, formal section 7 consultation with NMFS is required to ensure that the proposed action is not likely to jeopardize the continued existence of these listed species.

E.6.6.5.3 Determination of Effects on Listed Plant Species

Based on the pre-field review of literature, no listed plant species are expected to occur in the Project area and none were observed during focused surveys of the Project area. For this reason, relicensing of the Jackson Project as proposed would have no effect on listed plant species.

E.6.6.5.3 Determination of Effects on Listed Wildlife Species

Based on the analysis above, relicensing the Jackson Project as proposed would have no effect on the Canada lynx, gray wolf, or grizzly bear, or critical habitat for these species. The Project area does not provide suitable habitat for the Canada lynx, due to low elevations. The gray wolf may occur in the future, as populations in Idaho and British Columbia expand, but management of Project lands would not affect this species either positively or negatively. The grizzly bear may also occur in the future, but because grizzly bear populations are currently extremely small in the North Cascades Recovery Zone, it is unlikely that this species will re-occupy its former range, or if so, that it would be affected by Project operation.

The results of the pre-field review of literature and field surveys indicate that no spotted owls are present on or near Project lands. Over the long term, implementation of the TRMP, including protection of existing mature and old-growth forest and management of younger stands to accelerate the development of old-growth characteristics is anticipated to increase the amount of potential habitat that could be used for nesting, roosting, foraging or dispersal. Forest management and on-going recreation activities could cause noise disturbance to spotted owls if they are present in the future, but the District would implement disturbance avoidance measures to minimize this risk. For these reasons, relicensing of the Jackson Project as proposed may affect, but is not likely to adversely affect, the northern spotted owl. Relicensing would not affect critical habitat for the northern spotted owl, which is located approximately 1 mile or more from the proposed Project boundary near Williamson Creek.

Based on the field survey results, marbled murrelets occupy habitat in areas near Culmback Dam, Olney Pass, South Fork Spada Inlet, and Williamson Creek. Like the northern spotted owl, marbled murrelets would be expected to benefit from implementation of the TRMP, which calls for protection of mature and old-growth forest, and management of younger stands to promote old-growth structure. Implementation of the Marbled Murrelet Habitat Protection Plan would prevent the inadvertent loss of nest trees, and minimize the risk of disturbance during implementation of the TRMP, proposed recreation PM&Es, and on-going operations and maintenance. With this plan in place, relicensing the Jackson Project as proposed may affect, but is not likely to adversely affect, the marbled murrelet. Critical habitat on adjacent lands would not be affected by Project operation.

E.6.6.6 Essential Fish Habitat Conclusions

The Magnuson-Stevens Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH.

- NMFS must provide conservation recommendations for any Federal or State action that would adversely affect EFH.

- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS' EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting this definition of EFH, waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR §600.10). Adverse effect means any impact that reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR §600.810).

EFH consultation with NMFS is required regarding any federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

Pursuant to the MSA, the Pacific Fisheries Management Council designated EFH for three species of federally-managed Pacific salmon: Chinook, coho, and Puget Sound pink salmon. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers, and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). The Sultan River from its confluence to the Diversion Dam is considered EFH for Chinook, coho, and Puget Sound pink salmon.

As summarized in tables E.6.6-2 and E.6.6-3, the proposed action would not likely reduce the functioning of already impaired habitat or retard the progress of impaired habitat towards properly functioning conditions. Chinook salmon PCEs (habitat elements that support spawning, rearing, and migration) are the same elements that support EFH. The proposed action would not adversely affect ESA designated critical habitat for Chinook salmon. For this reason, we conclude that the proposed action would not adversely affect designated EFH for Chinook in the Sultan River. Coho and pink salmon have nearly the same fundamental habitat requirements as Chinook salmon. Because the proposed action would not adversely affect designated EFH for Chinook, the proposed action would not adversely affect designated EFH for coho and pink salmon in the Sultan River.

E.6.7 Recreation and Land Use

E.6.7.1 Affected Environment

E.6.7.1.1 Recreation

Spada Lake stores drinking water used by approximately 80 percent of the population of Snohomish County. Accordingly, recreation uses within the watershed are restricted to protect water quality. The District has developed several recreation sites on Spada Lake that provide multiple opportunities for day use activities. Water quality protection measures prohibit recreation activities that involve bodily contact with the reservoir or combustion powered watercraft. Access to the Sultan River is provided by the District at five sites downstream of the City of Everett's Diversion Dam.

The Project area attracts day use visitors to experience the forested foothill setting of Spada Lake. The most popular activities as indicated in the Recreation Visitor Survey (Snohomish County PUD and City of Everett 2006b) were sightseeing, hunting, resting/relaxing and picnicking. Other activities include boating (non-combustion engines), fishing, hiking, mountain biking, rock climbing and gold panning/ prospecting. The Sultan River downstream of Spada Lake is popular with anglers and periodically attracts whitewater boaters when flow conditions are appropriate. Two reaches are typically used by whitewater boaters: one above the Project Powerhouse (river segments 2 and 3) and one below it (segments 4 and 5). Access to segment 1 is limited and little information exists about its whitewater boating potential (boating conditions in this segment will be addressed during the proposed 3-year whitewater boating trial period). Boaters typically put-in and take-out at the Project's river access sites (Table E.6.7-1).

Currently, the FERC Project boundary encompasses only portions of the District's Spada Lake recreation sites. Portions of the South Fork, South Shore, and Nighthawk sites that are below elevation 1,460 feet msl are within the current FERC boundary.

Table E.6.7-1 Recreation sites operated and maintained by the District.

Spada Lake Recreation Sites/Acreages		Sultan River Public Access Sites	
Olney Pass	0.2 acres	Diversion Dam Road River Access	RM 6.5 and 7.3
South Fork	4.3 acres	Horseshoe Bend River Access	RM 6.8
South Shore	1.4 acres	Old Gaging Station Road River Access	RM 4.8
Nighthawk	5.1 acres	Powerhouse River Access	RM 4.3
Bear Creek	1.9 acres	Trout Farm Road River Access	RM 2.5 (5.0 acres)
North Shore	2.2 acres		

E.6.7.1.1.1 Developed Recreation Facilities

There are six recreation sites at Spada Lake that are publicly accessible and maintained by the District (Figure E.6.7-1). The Pilchuck entry at Spada Lake is listed as a recreation site under the current license; however, the only amenity at this site is directional signage. Additionally, the Culmback Dam recreation site was closed following September 11, 2001, and removed from the current license via a FERC order dated June 28, 2008. Five river access sites provide opportunities along the Sultan River for fishing, whitewater boating, hunting, and wildlife observation. These sites are identified in Table E.6.7-1 and detailed information about each is provided in Section E.5.7.1 of the District's Pre-Application Document (Snohomish County PUD and the City of Everett 2005). Available recreation sites, opportunities, and amenities are summarized below.

Project Facilities in the Spada Lake Area

The District provides day use opportunities for picnicking, shoreline fishing and boating/boat fishing (non-combustion engine and non-motorized only) via developed boat launches at three of the recreation sites along the southern lakeshore. Additional recreation sites along the southern shoreline of Spada Lake and one site on the northern side of the lake also offer individual and group picnicking opportunities, shoreline access for fishing (south shore only), wildlife observation, viewpoints of the reservoir and mountains, and interpretive opportunities. A developed site at Olney Pass is the gateway to the Spada Lake recreation area and includes visitor information, registration forms and restrooms. Primary amenities at each District-managed developed recreation site include:

- Olney Pass: visitor information, registration area, parking, and restrooms
- South Fork : 13 picnic sites, restrooms, car-top boat launch, and parking
- South Shore: gravel boat launch, restrooms, and parking
- Nighthawk: 13 picnic sites (some covered), restrooms, concrete boat launch, and parking
- Bear Creek: scenic overlooks, restrooms, and parking
- North Shore: 9 picnic sites (some covered), 2 scenic overlooks, restrooms, and parking

Spada Lake recreation activities are subject to restrictions that protect drinking water quality. As a result, swimming, combustion engine and inflatable watercraft use is prohibited. Watercraft allowed on the reservoir is limited to canoes and kayaks, sailboats, and craft powered by electric motors. In addition, overnight camping is not allowed on Project lands (see the District's Directive 73 – Public Use of Jackson Hydroelectric Project Recreation and Mitigation Lands, available on the District's web site at www.snopud.com).

With the exception of the Olney Pass site (which is open year round), the Spada Lake recreation sites are available for use from approximately mid-April through October 31. This use period corresponds with the typical WDFW-regulated fishing seasons. This is also the period when weather conditions usually enable passenger vehicle access into the basin. Spada Lake boat launches typically are accessible from April through October when lake levels accommodate boat trailers. The boat launches at Nighthawk, South Shore, and South Fork are usable down to reservoir pool level elevations of 1,425 feet, 1,415 feet, and 1,400 feet msl respectively. The South Fork boat ramp provides public car-top boat launching only. In late summer, reservoir drawdown is initiated for flood control, minimum river flow releases, and City of Everett drinking water supply requirements. This coincides with declining recreation use levels (compared to summer use levels).

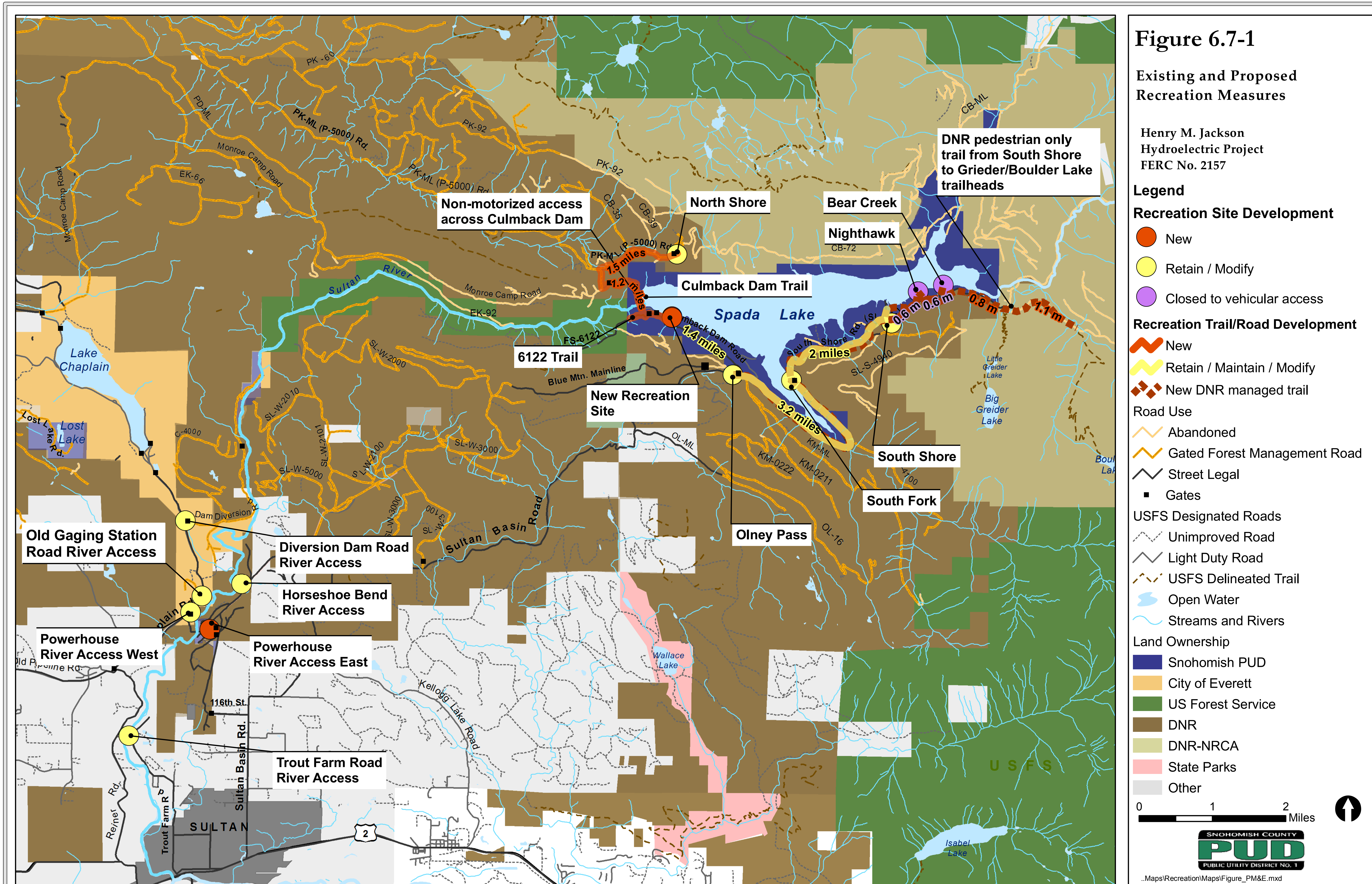


Figure 6.7-1

Existing and Proposed Recreation Measures

Sultan River Use Areas

Downstream of Culmback Dam, whitewater boating and fishing (bank and drift boat) are the two primary recreation activities on the Sultan River, along with prospecting. Recreational mining and prospecting is pursued by two clubs and several individuals holding established claims along the river. Parking is provided by the District at five river access sites between RM 7.3 and 2.5. These lightly-developed sites and their recreational amenities are listed below, with detailed information provided in the PAD (Snohomish County PUD and the City of Everett 2005) and the Recreation Needs Analysis (EDAW 2008):

- Diversion Dam Road River Access: roadside parking for 10+ vehicles and approximately 0.75 mile of informal trail to river
- Old Gaging Station Road River Access: roadside parking for 10+ vehicles and approximately 1.0 mile informal trail to river
- Powerhouse River Access: parking for 20+ vehicles and approximately 0.50 mile of informal trail to river
- Horseshoe Bend River Access: parking is allowed along the pipeline right-of-way and several informal trails provide access to the river
- Trout Farm Road River Access: paved parking for 8 vehicles and a short trail to the river

Access is restricted to the Diversion Dam Road and Old Gaging Station Road River access sites because they are reached via the Lake Chaplain Road, which the City opens from 6 a.m. to 6 p.m.

Whitewater boaters use multiple segments of the Sultan River. Boaters may paddle each segment independently, but under suitable flow conditions, they can paddle multiple segments as one contiguous stretch. The upper whitewater boating reach extends from Culmback Dam downstream to the Powerhouse. This reach consists of three segments: Segment 1: Culmback Dam to the 6122 Trail (RM 16.5 to 15.7), Segment 2: 6122 Trail to Diversion Dam (RM 15.7 to 9.7), and Segment 3: Diversion Dam to Powerhouse (RM 9.7 to 4.3). Rapids rated as Class III to IV+ typically can be experienced on a yearly basis in the upper reaches, but are unpredictable and usually of short duration.

The downstream boating reach begins at the Powerhouse and continues to the confluence with the Skykomish River. This reach consists of two segments: Segment 4: Powerhouse to Trout Farm Road River Access Site (RM 4.3 to 2.5) and Segment 5: Trout Farm Road River Access Site to Skykomish River (RM 2.5 to 0.0). In the lower river, whitewater boaters are the primary users of Segment 4, as it provides a challenging run with predominantly Class III and some Class IV+ rapids. Segment 5, the least challenging reach, is used by a broader spectrum of watercraft.

Lost Lake Use Area

Lost Lake is a 14-acre lake in a parcel of wildlife habitat land owned and managed by the District. To protect wildlife habitat values, only pedestrian access is allowed. Distances from the nearest public roads to Lost Lake range from approximately 1.5 to 5.0 miles.

Recreation activities in the Lost Lake area typically include photography, picnicking, hunting, and fishing. Non-motorized, inflatable watercraft are allowed on the lake and a platform provides shoreline fishing opportunities and protection to the surrounding bog.

E.6.7.1.1.2 Recreation Use, Demand and Capacity

The proximity of the Project area to major population centers, as well as its remote forested setting in the Cascade foothills, attract visitors to this area. These characteristics, coupled with its high annual rainfall and narrow river gorge led to establishing the basin as a municipal water supply watershed. This in turn, necessitates water quality-related regulations and restrictions that likely depress recreation use levels. Specifically, Project lands around Spada Lake are accessible only for day use and the reservoir is available for non-contact uses and non-combustion engine boating only.

At Spada Lake, sightseeing and hiking tend to be the primary activities (based on use estimates), while fishing and hiking are the primary pursuits on the Sultan River and at Lost Lake. Other typical recreation uses of Project lands and facilities include boating, picnicking, mountain biking, and various other outdoor activities. Spada Lake provides flatwater boating and trout fishing opportunities, while Project roads are available for hiking and mountain biking. The Sultan River is a popular recreational fishery for steelhead and pink salmon, and at certain times the Sultan River also experiences some whitewater boating use.

Annual Project area recreation use is estimated at approximately 8,500 recreation days per year (EDAW 2008). At Spada Lake, recreational use tends to be highest during the summer months (June-August), while use levels tend to be more evenly distributed throughout the year along the Sultan River and at Lost Lake. Future recreational use at the Project is anticipated to increase. Annual use levels are estimated to increase to between 11,000 and 18,800 recreation days by 2061 depending primarily on increases in the state population, as well as activity participation rates.

The DNR's Greider Lakes Trail/Trailhead near the east end of Spada Lake typically receives the highest recreation use level in the Project area. Of the District-managed shoreline recreation sites, the South Fork Recreation Site typically receives the most annual use, followed by the Nighthawk, South Shore, and Bear Creek recreation sites. Along the Sultan River, recreation use is highest at the Diversion Dam Road River Access, followed by Horseshoe Bend, Powerhouse, Old Gaging Station, and Trout Farm Road river access sites.

Whitewater boating downstream of Culmback Dam can occur when suitable flows are available. The reach from Culmback Dam to the Powerhouse is only occasionally boatable, typically averaging about four days/year. The reach from the Powerhouse to the Trout Farm Road River Access site provides suitable flows for boating approximately half the year. Current demand for whitewater boating in this reach is difficult to estimate, but is thought to be relatively low due to limited optimal flow conditions in the summer and challenging launch access (Whittaker and Shelby 2008).

Current recreation and public use levels throughout the Project area are considered below capacity (EDAW 2008). Three capacity types were explored during the Recreation Needs Analysis (biophysical/ecological, social, and management) and are considered below capacity and are not anticipated to reach or exceed capacity at recreation sites in the future, assuming use variables remain constant. Water quality protection measures and associated recreation use regulations and restrictions limit the recreation capacity in the Project area, particularly around Spada Lake.

E.6.7.1.2 Land Use

E.6.7.1.2.1 Project Area Ownership and Management

The Project is set in the rural foothills of the Cascade Mountains in an area of Snohomish County historically dominated by timber management activities. The rugged Sultan River basin still supports timber harvesting, although much of the area has been managed as a municipal drinking water supply watershed since 1917. In other parts of the basin, active timber management still occurs, though rural residential uses are expanding. Primary land uses in the basin include commercial forestry, recreation, wildlife and aquatic habitat, and municipal drinking water supply. Land within the existing FERC Project boundary is mostly owned by the District with some additional parcels owned by the City of Everett, the State of Washington (DNR), federal government (Mt. Baker-Snoqualmie National Forest), City of Sultan, and a few private landowners (Table E.6.7-2). Land adjacent to the Project that is currently managed for Project purposes is owned by the City of Everett, and the DNR.

Table E.6.7-2 Land Use in the Existing FERC Project Boundary, and adjacent land managed for the Project.

Owner / Parcel	Area inside the Project Boundary	Area Outside the Project Boundary	Total Area
District	2,143.3	2,134.5	4,277.8
Spada Lake Tract	2,112.9	1,537.0	3,649.9
Lake	1,892.0	16.3	1,908.3
Land	221.3	1,520.7	1,742.0
Recreation Sites	3.5	8.9	12.4
Non-Recreation Sites	217.8	1,511.8	1,729.6
Lost Lake Tract	0.0	213.8	213.8
Lake	0.0	14.2	14.2
Land	0.0	199.6	199.6
Williamson Creek Tract	0.6	376.0	376.6
Project Facilities Tract	27.0	7.8	34.8
Non WHMP Tract	2.7	0.0	2.7
City of Everett	27.3	2,680.9	2,708.2
City of Sultan	2.3	0.0	2.3
DNR	98.9	13.5	112.4
US Forest Service	10.9	0.0	10.9
Private / Undefined	3.4	5.0	8.4

The District owns approximately 4,278 acres in the Sultan River basin. This ownership extends beyond the current FERC Project boundary. The current FERC Project boundary around Spada Lake is defined by a metes and bounds survey that mostly follows the contour elevation of 1,460 feet msl; however there are some deviations from this contour (see Exhibit G). The Spada Lake Tract of the Project boundary totals approximately 2,113 acres. The District acquired land beneath and surrounding Spada Lake in 1991 through a land exchange with the Forest Service and DNR. A 214-acre tract around Lost Lake was purchased by the District in 1988 as part of the WHMP, to provide dedicated wildlife habitat and to protect is from residential development. The District also owns or manages land occupied by Project facilities that include the Powerhouse, the pipeline right-of-way between the tunnel portal and the Powerhouse, a wedge-shaped parcel adjacent to the Powerhouse access road, and the pipeline right-of-way between the Powerhouse and the City of Everett Diversion Dam. The District has permanent easements from the DNR, Lake Bronson Associates and others for Project facilities that are located on land not owned by the District.

Table E.6.7-2 above identifies all the areas within the FERC Project boundary and adjacent land (outside the FERC Project boundary) managed for Project purposes. Some of the items listed in the table need further clarification.

- The 16.3 acres for Spada Lake that lie outside the current FERC boundary result from differences in mapping technologies, and the time periods when the areas were defined. The FERC Project boundary was defined by a metes and bounds survey using mapping information at the time the Project was constructed. The current lake boundary is defined by the full pool elevation level (1,450 feet msl.), and has been identified using highly accurate LiDAR imagery mapping techniques available in recent years.

- There are 221 acres of Project land between Spada Lake at full pool and the current FERC boundary.

- The recreation sites adjacent to Spada Lake are partially within the current FERC boundary; however most recreation site areas are on District land outside of the current FERC boundary.

- The Project Facilities Tract includes 7.8 acres of District land in a parcel adjacent to the Powerhouse. This parcel includes the District’s wedge-shaped parcel; however its size has been under-represented in the geographic information system (GIS) mapping database.

- DNR ownership occurs primarily along the power pipeline ROW between Culmback Dam and the Powerhouse, and the pipeline between the Powerhouse and the City of Everett’s Diversion Dam, where the District has an easement for the use of this land.

- The private / undefined 5-acre parcel identified outside of the Project boundary is the District's Trout Farm river access site. This information is incorrectly identified in the GIS ownership database for the Sultan River basin.

The City of Everett owns several sections of land surrounding Lake Chaplain and Chaplain Creek, extending south to the creek's confluence with the Sultan River near the Jackson Project Powerhouse. It also has an isolated holding that encompasses the Diversion Dam and diversion tunnel outlet on the Sultan River. City ownership adjacent to the Project is approximately 2,681 acres, which is currently managed under the Jackson Project WHMP. Through a 2008 agreement with the City of Everett, the District also retains the rights to use City land for Project purposes.

The District manages most of its land within five tracts under the WHMP and associated resource management plans. These five tracts and the extent of their coverage are described in Section E.6.4.1.2. In addition to terrestrial habitat protection, this land is used by the public for various recreation activities. The City manages the Lake Chaplain Tract according to the City's "Watershed Control Plan" and "Water System Plan Update" and has incorporated the WHMP as part of such plans. Public use is prohibited within the areas that drain to Lake Chaplain, while surrounding areas are available for low impact day use recreation.

At the time of Project construction, the Forest Service was a major land owner in the basin. Through a series of land exchanges in the early 1990s, this presence has been reduced significantly. The Forest Service retains approximately 1,750 acres along the Sultan River below Culmback Dam, beginning a short distance downstream of the dam and extending to a point approximately 0.5 miles upstream of the City of Everett Diversion Dam, a distance of about 6.0 river miles. In addition, the Forest Service retains portions of two sections south of Culmback Dam and is the major land owner to the east of the Project area.

With approximately 45,000 acres, the DNR is the largest land and resource management entity in the basin. DNR-managed land is within two general management categories, state trust land and NRCAs. State trust land is managed in trust for the benefit of institutions of the State of Washington, including schools and universities. NRCA land possesses outstanding scenic and ecological value and is managed to protect the habitat of threatened, endangered, and sensitive plants and animals; to provide opportunities for environmental education; and to allow low impact public use. As described in Section E.6.7.2.1.1, the DNR recently combined three separate NRCA units into a single larger 26,309-acre unit called the Morning Star NRCA. State trust land currently totals approximately 18,600 acres in the basin.

Private ownership in the areas draining into Spada Lake is limited primarily to a few small in-holdings in the upper Williamson Creek and North Fork drainages. Downstream of Spada Lake, in the vicinity of the Project pipeline, two sections of land are retained in private ownership. There is mixed use of these parcels, including timber production, rural home sites, recreational development, and commercial structures. Downstream of the Powerhouse, the ownership characterization changes, and with the exception of a few

DNR land holdings, all land is privately held, with mixed rural home sites and timber production land.

E.6.7.1.2.2 General Access Patterns

U.S. Highway 2, extending to the east and west along the Skykomish River, is the primary travel route in the vicinity of the Project. County roads intersect U.S. 2 and provide access to the Sultan River basin and Project facilities at Spada Lake, the power pipeline and Powerhouse, wildlife mitigation land near Lost Lake, and recreation in the lower Sultan River. Roads in the Project vicinity are owned and maintained by a variety of entities including Snohomish County, DNR, Forest Service, the District, the City of Everett, and some private entities. The ownership of roads, road easements, and access limitations for roads associated with Project land and facilities are listed in Table E.6.7-3.

Table E.6.7-3 Roads related to Project land or facility access.

Road	Owner	Provides Access To:	Access Limitations
Sultan Basin Rd.	Snohomish County	Provides access to Olney Pass from State Highway 2 and the City of Sultan. Links to other roads that provide general access to Project land or facilities on the south side of Spada Lake and the east side of the Sultan River. This road also provides access for other landowners in the basin.	None
Culmback Dam Rd. (between Olney Pass and Culmback Dam)	District	Provides access to Culmback Dam from Olney Pass. This road also provides access to Forest Service and DNR managed land.	This road is gated at Olney Pass; however it is open to the public at all times, except when the Homeland Security Threat is higher than yellow, or weather or other safety conditions warrant closure. An additional gate is located approximately 0.3 miles south of Culmback Dam (just past the intersection with Forest Road 6122) to prohibit public access to Culmback Dam.
Culmback Dam Rd. (between Culmback Dam and Pilchuck Mainline Rd.)	Mixed (District and DNR)	Provides access to North Shore recreation site for administrative purposes. This road also provides access to DNR managed land. The District has a use easement with the DNR for the portion of the road segment on DNR land.	Public vehicular access is restricted on this road segment due to the District gate at Culmback Dam and the DNR gate on the Pilchuck Mainline road. Public non-vehicular access

Road	Owner	Provides Access To:	Access Limitations
			is allowed from the gate on the Pilchuck Mainline road. Public access onto Culmback Dam is prohibited.
Pilchuck Mainline Rd.	DNR	Provides public non-vehicular access to the North Shore recreation site from the DNR gate approximately 13.5 miles west of the recreation site. This road also provides administrative access to DNR managed land.	Public access is restricted to non-vehicular travel. The road is open to the DNR vehicles for administrative purposes.
North Shore Rd.	Mixed (District and DNR)	Provides no access to Project land or facilities.	This road was formally abandoned by the DNR approximately 1 mile east of the North Shore recreation site in 1999. Vehicular travel on this road is no longer possible.
Forest Road 6122	Mixed (District and USFS)	Provides access to District land managed for wildlife habitat and Forest Service and DNR land managed for multiple use. The District has a use easement with the Forest Service for the portion of the road segment on Forest Service land.	Public access to this road is available at all times, except when the Homeland Security Threat is higher than yellow, or weather or other safety conditions warrant closure of the gate at Olney Pass.
South Shore Rd.	Mixed (District and DNR)	Provides access to District land along the south shore of Spada Lake. This road also provides access to DNR managed land. The District has a use agreement with the DNR for the portion of the road segment on DNR land.	This road is gated at Olney Pass; however it is open to the public at all times, except when weather or other safety conditions warrant closure.
DNR Roads SL-W-2000, SL-W 2100, and SL-W-3000	DNR	Provides access to the Blue Mountain communication site from the Sultan Basin road. The District has a use agreement with the DNR for access to the Blue Mountain communication site for the term of the site lease.	These roads primarily provide access to DNR managed land and are gated by the DNR to prohibit public access.
Blue Mountain Mainline Rd.	DNR	Provides access to the Blue Mountain communication site from Olney Pass. This road also provides access to DNR managed land. This route is commonly used to access the Blue Mountain communication site.	This road is gated at Olney Pass by the DNR to prohibit public access.

Road	Owner	Provides Access To:	Access Limitations
Diversion Dam Rd.	Mixed (City of Everett and DNR)	Provides access to a river access point for recreationists. This road also provides administrative access to the Diversion Dam for the City of Everett and provides access to DNR managed land.	This road is gated at the Lake Chaplain Rd. and is open to the public from 6 a.m. to 6 p.m. year round.
Powerhouse Access Rd. (from Lake Chaplain Rd.)	Mixed (City of Everett and DNR)	Provides access to the Powerhouse and a river access point for recreationists. This road also provides access to City of Everett and DNR managed land.	This road is gated at the Lake Chaplain Rd. and is open to the public from 6 a.m. to 6 p.m. year round.
Powerhouse Access Rd. (from Sultan Basin Rd.)	Mixed (District, County, and DNR)	Provides access to the Powerhouse and a river access point for recreationists. This road also provides access to DNR and private land.	This road is gated above the Powerhouse. Recreationists may park outside the gate and walk a short distance to the Powerhouse bridge.
Lost Lake Access Rd. (from Lake Chaplain)	Mixed (District City of Everett, DNR)	Provides access to District land managed for wildlife habitat. Also provides access to forest land managed by other land owners. The District has a use agreement with the City of Everett, and other land owners for the portion of the road on these other properties.	Public access via City of Everett land within the hydrologic boundary of Lake Chaplain is prohibited. Pedestrian public access from outside the hydrologic boundary of Lake Chaplain, generally from the south or west of Lost Lake, is permitted.
Power Pipeline and Pipeline Access Rd.	Mixed (DNR, City of Sultan, and Private)	Provides access to the power pipeline between the tunnel portal and the Powerhouse, and a river access point for recreationists. The District has a use agreement with the City of Sultan for the portion of the road on City of Sultan property and easements from the DNR and other private land owners for the power pipeline right-of-way.	The southern portion of this road is open to the public from the Powerhouse access road. The power pipeline right-of-way is gated at the City of Sultan property boundary to protect their water quality. The northern portion of the power pipeline right-of-way is also behind DNR gates that prohibit public access.
Trout Farm Rd.	Snohomish County	Provides access to District land managed for river access and recreation. The Trout Farm Road also provides access to rural residential property adjacent to the City of Sultan.	The recreation and river access site is gated at the District property boundary adjacent to Trout Farm Road and the gate is opened for vehicular access during periods of high use and upon prearranged request, during daylight hours.

Access to Spada Lake from Sultan is controlled by two District-maintained gates at Olney Pass. The South Shore Road and Culmback Dam Road are part of the DNR Spada Lake Mainline. DNR is the land management entity primarily responsible for maintaining the South Shore Road and the District is the landowner responsible for maintaining the Culmback Dam Road.

The gate to the South Shore Road is opened for general public access to the District's Spada Lake recreation sites and DNR land, except when safety issues such as snow and ice accumulation warrant closure of the roads. The gate to Culmback Dam Road is open to the public for access to Forest Service land to the south and west of Culmback Dam. The District's Culmback Dam Road provides access for District staff to Culmback Dam and formerly provided public access across the dam to the DNR's Pilchuck Mainline Road, the only road extending along the north side of Spada Lake. The Pilchuck Mainline Road was formally abandoned by the DNR just east of the District's North Shore Recreation Site in 1999. The road previously extended east to the Williamson Creek area and provided access to District-managed land and the privately owned parcels in the Williamson Creek drainage. In November 2005, the DNR closed the Pilchuck Mainline Road to vehicular travel by the general public northwest of Spada Lake due to increasing environmental and public safety concerns. The Pilchuck Mainline Road continues to be open for DNR administrative uses.

In 2005, a gate was placed on the Culmback Dam Road just beyond the junction with Forest Road (FR) 6122 (approximately 0.3 mile southeast of Culmback Dam), and the gate at Olney Pass is left open as long as the Department of Homeland Security threat level remains at yellow or below and no safety issues warrant closure of the road. Public access is allowed to FR 6122, but not to the dam. FR 6122 is approximately 1 mile long and provides access to Forest Service land, mineral claims and the Sultan River gorge.

The District maintains a road network on Project land. The District developed a road maintenance and abandonment plan (RMAP) and obtained DNR approval in 2001 for approximately 20 miles of road. Generally, these roads are maintained to standards defined in the Washington Forest Practices Rules and Regulations. District staff inspects each road segment annually and following large-scale storm events to ensure integrity of the road bed and properly functioning drainage facilities.

E.6.7.1.2.3 Shoreline Management Policies and Buffer Zones

FERC does not require licensees to prepare shoreline management plans to manage the shoreline, but strongly encourages the use of this tool to manage shorelines at facilities experiencing development pressure. This circumstance is not pertinent to the Jackson Project and Spada Lake because of its status as a municipal drinking water watershed. As a result, the Spada Lake shoreline will remain undeveloped and protected. Under the current Project FERC license, public access to Project land and water is allowed, including hunting and fishing access except in watershed areas closed to protect public health. Areas identified in the 1961 license as closed are Lake Chaplain and the Diversion Dam on the Sultan River. The area around the Diversion Dam is now accessible to the public, except within 400 feet of the structure. The license granted the District, City, Snohomish County, and the Washington State Department of Health the authority to restrict public access to other Project areas that may constitute a hazard to health and safety. The most significant action taken was in response to the terrorist events in September 2001. Public access approaching and crossing Culmback Dam has since been prohibited. A “no trespassing” sign is posted on the gates leading to Culmback Dam.

Spada Lake Tract

The shoreline surrounding Spada Lake is managed to maintain water quality for the municipal drinking water supply. Although a formal buffer zone has not been established around the lake, use restrictions in the form of regulations that apply to the lake, its shorelines, and watershed as a whole were developed by the City and the District. These regulations seek to balance water quality protection with public use opportunities. Restrictions include the following:

- Public access is allowed within 200 feet of the Spada Lake shoreline only in designated recreation areas.
- Bank fishing is permitted only along the south shore of the reservoir, from the North Fork of the Sultan River west to the section line between Sections 29 and 28.
- Launching or landing boats is permitted only from designated recreation sites along the south shore.
- Overnight camping is prohibited, except at the DNR’s Boulder Lake and Greider Lake campgrounds.

Lake Chaplain Tract

Lake Chaplain and surrounding land is owned by the City of Everett. This 424-acre lake, which is not part of the FERC-licensed Project, is the terminal reservoir for drinking water supply for the City of Everett and the majority of Snohomish County. Public access is not permitted within the Lake Chaplain hydrographic boundary. However, pursuant to Project license conditions, City-owned land directly south of the Lake Chaplain hydrographic boundary, and the adjacent filtration plant is open to the public for day-use recreation, with certain restrictions. Sultan River Public Access Sites at the Old Gaging Station road and along the Diversion Dam road are located in this tract.

Sultan River

The upper portion of the Sultan River below Culmback Dam is under Federal ownership and administered by the Forest Service as guided by the Forest Plan for the Mt. Baker - Snoqualmie National Forest (USFS 1990, as amended by the NW Forest Plan [USFS and BLM 1994]). This includes an area from District ownership approximately 0.25 miles downstream of Culmback Dam down to a point shortly above the Diversion Dam, and corresponds roughly to Operational Reach 3 (OR-3). The portion of the Sultan River below Culmback Dam that is outside of Federal ownership is under the jurisdiction of land use regulations for the City of Sultan within its urban growth boundary (City of Sultan 2007), and Snohomish County land use regulations for other areas (Snohomish County 2006). The urban growth boundary for the City of Sultan includes the east bank of the Sultan River for approximately the lower half of Operational Reach 1 (OR-1), and the west bank for the bottom mile of the Sultan River.

Mitigation and enhancement measures proposed in areas adjacent to the river within the jurisdiction of the Forest Plan for the Mt. Baker - Snoqualmie National Forest, or the City or County Shoreline Management Plans would have to be consistent with policies and regulations described in those documents.

E.6.7.1.2.4 Floodplains

Floodplains are determined by the Federal Emergency Management Agency (FEMA) and areas subject to flooding are plotted on its Flood Insurance Rate Maps (FIRM). Portions of the Sultan River were mapped in 1999.

Lost Lake, Lake Chaplain and a reach of Chaplain Creek approximately 0.25-miles downstream of Lake Chaplain are designated as Zone A. Zone A land is within the estimated 100-year floodplain. Within this designation, local communities are responsible to ensure that new development is constructed to minimize flood damage. The lower reaches of the Sultan River, extending downstream from a point approximately 1.5 miles below the Jackson Powerhouse, were subject to detailed hydraulic analysis. The 100-year floodplain is mapped to the mouth of the Sultan River. The only Project feature within the mapped floodplain is the Trout Farm Road river access point (FEMA 1999). High flows in this lower reach of the Sultan River are moderated by the operation of the Project.

E.6.7.2 Project Effects

E.6.7.2.1 Recreation

The Recreation Needs Analysis (EDAW 2008), Flow Recreation Study (Whittaker and Shelby 2008), and agency, tribal, and stakeholder consultation identified continuing recreation impacts including:

- Adequacy of existing Project recreation facilities and public access to meet current and future demand;
- Effects of vandalism and illegal activities on the quality of the recreation experience and environmental resources;
- Effects of Project operations on availability of flows for whitewater boating; and
- Effects of any proposed whitewater boating flows on aquatic resources in the Sultan River (FERC 2006).

E.6.7.2.1.1 Adequacy of Existing Recreation Facilities to Meet Demand

The Project directly and indirectly affects recreation resources within and adjacent to the Project boundary and in the reach of the Sultan River below Culmback Dam. These effects include providing public access to open space areas for a variety of recreation activities, and access to and use of the river and Spada Lake for recreation purposes. As described above, the District developed and operates several public day use recreation facilities on Spada Lake, at Lost Lake, as well as river access sites below Culmback Dam. The Project controls river flows for power generation and flood control below Culmback Dam. These operations, as well as public use restrictions related to the protection of the City's municipal drinking water supply source, directly affect public use of the lands and water of the Sultan River basin.

The Project provides opportunities for visitors to participate in many types of outdoor activities, although the Sultan basin is but one of many regional areas providing similar outdoor recreation opportunities. The Project provides opportunities for various types of flatwater and river-based recreation, as well as land-based activities that are enhanced by the presence of the reservoir, river and the Project's distinctive setting (mid-elevation forests surrounding the lake and a dramatic forested river canyon). Many of these opportunities, both on and around Spada Lake and the Sultan River, are considered to have a Project nexus (i.e., outdoor activities are induced by the Project) and are considered a beneficial effect of the Jackson Project.

As noted in Section E.6.7.1.1.2, current annual recreation use at the Project is approximately 8,500 recreation days. Most visitors (92 percent) are generally satisfied with their current experience (EDAW 2008). Future recreation use in the Project area is estimated to range from approximately 11,000 recreation days (low scenario) to about 18,800 recreation days (high scenario) by 2061, the requested term of a new 50-year FERC license. This represents an increase of about 30 to 123 percent over current use levels, which are considered to be below capacity. Even with robust growth in recreation activity participation, use levels at the existing developed recreation sites are not anticipated to reach or exceed capacity. While use levels will likely remain within acceptable levels during the anticipated license term, other factors may limit public use.

Biophysical and management capacity are considered limiting factors to recreation use because of the water quality protection measures required by the City of Everett and Washington State Department of Health. This is not to imply that water quality-related use regulations and restrictions are unacceptable and should be modified; rather it is an acknowledgement of the outcome that these measures have on recreation use levels in the Project area. For some visitors, these water quality restrictions may be perceived as an adverse effect; however, for others, specifically those seeking a less crowded experience, the Project's lower use levels that may result in part from these restrictions are likely perceived as a beneficial outcome.

Relicensing studies and associated consultation identified an interest in additional non-motorized trails at the Project. Currently there are no District-managed developed recreation trails, although informal trails link the Sultan River access sites to the river. In the Project area, DNR provides two hiking trails (Boulder Lake and Greider Lakes) and area roads are also used as de-facto motorized and non-motorized trails. In addition, the DNR allows non-motorized uses (hiking, biking, and horseback riding) on the segment of the Pilchuck Mainline (PK-ML) Road as far as the District's North Shore Recreation site, which is currently the only public access route to this site. While there are multiple trail opportunities in the Project region, demand for these types of opportunities appears to be growing (at both the state and national levels).

A trails workshop conducted by the District revealed stakeholder support for maintaining access routes to existing recreation opportunities, including the District's developed recreation sites along Spada Lake, the DNR's trails, the Static Point climbing area, and various locations along the Sultan River, among others. While vehicular access is still important, non-motorized trails to many of these opportunities seemed appropriate to many stakeholders.

Access to the District's South Shore facilities was thrown into question during relicensing when the DNR announced its intension to implement several significant land management changes that would affect trail and other recreation uses in the Project area. Recently the DNR added to the established Morning Star NRCA by combining the three existing NRCA units located to the north, east, and south of Spada Lake. To meet their management objectives, the DNR intends to abandon the South Shore Road beyond Olney Pass (see Section E.6.7.3.2.2). Other reasons for abandonment are that the road requires substantial maintenance and repair on a regular basis, and needs to be upgraded to current State Forest Practice Standards. Access to the District's South Shore recreation sites will be affected by this action. The DNR proposed to convert the abandoned road to a trail, resulting in pedestrian-only access to the District's developed sites. The trail will be designed to allow ORV access for maintenance and inspection by District, City and DNR staff. In conjunction with this change, the DNR plans develop new trails to access their Greider Lakes and Boulder Lake trails.

The DNR's planned abandonment of South Shore Road east of Olney Pass prompted plans by the District to assume management of a portion of this road in order to maintain vehicular access to several of its developed lakefront sites. As described in Section E.6.7.3.1, the District does not intend to provide road access to two of its developed sites, which will be accessed by the DNR's trail conversion. The District would modify some of its recreation sites on Spada Lake to address this loss of vehicular access.

E.6.7.2.1.2 Effects of Illegal Activities on Recreation Use and Project Lands

During NEPA scoping, illegal activities conducted in the Project area were identified as an issue for evaluation because of the potential to detract from legal recreation pursuits and to cause resource damage. The remote location and limited access into the Sultan River basin creates a circumstance that attracts some level of illegal activity, chiefly vandalism, discharge of firearms, and unauthorized dumping. Improved roads to developed recreation sites provide easier access for both legal and illegal pursuits both on and off Project lands. Because this watershed is used for municipal supply, visitor activities that potentially compromise water quality are a typical use violation.

Reducing illegal activities is a challenge to all managers of remotely located public lands. The District combats this by carefully maintaining its recreation sites and use areas. Sites are regularly patrolled by District staff in conjunction with their other responsibilities and by the City of Everett watershed patrol. The City is committed to continuing watershed patrol as stated in their 2007 Comprehensive Water Plan. The District contracts with the

Snohomish County Sheriff's Office for additional patrols at the recreation sites and Project lands throughout the recreation season, typically April through October. No relicensing study directly addressed this issue nor was a specific PM&E measure developed; however, the District proposes to continue addressing this challenge with increased monitoring as a component of its proposed Recreation Resource Management Plan (see Section E.6.7.3.1.1).

E.6.7.2.1.3 Flow Dependant Recreation Opportunities

Project development created a new set of recreational opportunities within the Sultan River basin while at the same time diminishing other recreation opportunities. Flatwater boating opportunities were created at Spada Lake, but at the expense of whitewater boating in reaches that experienced river flow reductions. Advocates for whitewater boating and various state and federal recreation agencies concurred that this effect should be examined during relicensing; therefore, the District planned and conducted the Flow Recreation Study (Whittaker and Shelby 2008).

Project operations affect the seasonal flow pattern in the Sultan River by storing winter and spring runoff for power generation, municipal water supply, instream flow augmentation for salmon and trout species, and flood control. Under normal operations, all but minimum fisheries flows (20 cfs plus accretion flows) are diverted at Culmback Dam, although very rare spills may provide higher flows. Higher base flows are provided between the City's Diversion Dam and the Powerhouse (from 95 to 175 cfs depending upon the season). Outflows from power generation (released at RM 4.5) contribute additional water to downstream reaches. Detailed information about flows in the Sultan River and the effect of Project operations is presented in Sections E.6.2.1.1 and E.6.2.2.1.

As described in Section E.6.7.1.1.2, Table E.6.7-4, and below, the primary recreation uses on the Sultan River are fishing, whitewater boating, and mineral prospecting. In general, Project operations and specifically Project-related instream flows are likely perceived as an adverse effect by whitewater boating enthusiasts, but as a beneficial effect by anglers and prospectors who seem to prefer the lower flows.

Table E.6.7-4 Recreation Flow Study reaches and typical recreation uses.

Segment	River Mile	Location	Typical Recreation Uses
1	RM 16.5 to 15.7	Culmback Dam to 6122 Trail	Mining, Class IV-V whitewater boating
2	RM 15.7 to 9.7	6122 Trail to Diversion Dam	Mining, Class IV whitewater boating
3	RM 9.7 to 4.5	Diversion Dam to Powerhouse	Mining, fishing, Class IV whitewater boating
4	RM 4.5 to 2.5	Powerhouse to Trout Farm Road River Access	Fishing, Class III whitewater boating
5	RM 2.5 to 0.0	Trout Farm Road to Skykomish River	Fishing from boats, wading, boating, Class I-II whitewater boating, swimming

Segment 1: Recent observations by experienced whitewater boaters indicate that some of the rapids may be boatable at flows between 300 and 1,000 cfs, although other rapids may be unboatable and would require portaging. Because of these challenges plus its short length, this segment was determined to be a lower priority to boaters than other segments and thus was not examined in detail by the Recreation Flow Study (Whittaker and Shelby 2008).

There is one mining claim in this reach, a short distance downstream of Culmback Dam. No other recreation uses were identified in this reach.

Segment 2: The whitewater difficulty of Segment 2 is generally Class III-IV. Acceptable and optimal boating flows are identified in Table E.6.7-5 for both kayaks and small rafts.

There are several mining claims in this segment, some with year-round permits. These claims are primarily worked from March through October, although one claimant is authorized to be in the river through December. Base flows rarely exceed about 20 cfs in Segment 2, allowing good access for wading and dredges. Target sediments in the bottom of the channel usually are clear.

Table E.6.7-5 Whitewater boating flows identified in Sultan River segments 2, 3 and 4.

Type of Craft	Transportation Flows[1]	Technical Trip[2]	Standard Trip[3]	Big Water Trip[4]
Segments 2 and 3				
Kayak	300 cfs	450-500 cfs acceptable	750-1200 cfs acceptable	Seg.2: >1,000 cfs Seg.3: >1,200 cfs
		600-650 cfs optimal	900-950 cfs optimal	
Small Raft	700 cfs	850 cfs	950 cfs acceptable	>1,200 cfs
			1000 cfs optimal	
Boater Recommended Average Flows: 900 to 1,200 cfs				
Segment 4				
Kayak	400 cfs	500 cfs acceptable	850 cfs acceptable	>1,150 cfs Acceptable
		600 cfs optimal	1000 cfs optimal	>1,600 cfs Optimal
Boater Recommended Average Flows: 1,000 to 1,400 cfs				

1 Transportation Flows: Can be boated but with some rock contact, limited route options and little whitewater.
2 Technical Trip: Lower flow trip without powerful hydraulics. Some portaging may be required.
3 Standard Trip: Higher flow trip with route options, stronger hydraulics, larger waves with few boatability problems; generally preferred over technical trips.
4 Big Water Trip: Powerful hydraulics that can be more challenging. Provides diverse boating experience.

Segment 3: The whitewater difficulty of Segment 3 is generally rated as Class III-IV, with one Class V rapid (which can be portaged). Acceptable and optimal boating flows are identified in Table E.6.7-5 for both kayaks and small rafts.

There are several mining claims in this reach. Base flows are less than 100 cfs in Segment 3 and allow good wading and dredge access, and target sediments in the bottom of the channel are visible at this flow level.

Anglers who were interviewed as part of the Recreation Flow Study rated optimal flows for fishing as from 300 to 400 cfs in Segment 3.

Segment 4: Whitewater boating in Segment 4 is generally Class III with one Class IV rapid. Study findings for Segment 4 were similar to Segments 2 and 3, although boaters generally specified slightly higher flows for each type of opportunity (Table E.6.7-5).

Anglers identified a broad range of preferred flows in Segment 4. Flows from 400 to 1,400 cfs allow drift boats to operate, whereas bank fishing is not as flow dependent since fishable areas can be accessed at a range of water levels.

Segment 5: There is little whitewater use of this segment and it was not examined in detail by the District's study. Flows preferred by anglers were reported to be in the same ranges as Segment 4. Other recreation activities in this segment include swimming during summer and general non-flow dependent activities such as picnicking and socializing.

Preferred flow ranges identified by whitewater boaters for river Segments 2, 3 and 4 are presented in Table E.6.7-5. Boaters were asked to compare Sultan River segments to other rivers in the region. Segments 2 and 3 are highly regarded in the region and statewide (with Segment 3 receiving slightly higher ratings). Segment 4 was rated slightly lower.

E.6.7.2.2 Land Use

The Project is located in a remote rural part of Snohomish County where the dominant land use is forest management, however some land owners in the area also place an emphasis on conserving natural areas for their ecological attributes. The District's existing land ownership and objectives for managing the land for wildlife habitat and recreational access is compatible with other land owners and existing land uses in the area. Most of the District's land for the Project is located within Snohomish County's Forest zone, including all wildlife mitigation land and recreation sites surrounding Spada Lake. The District owns only one land parcel, the Trout Farm Road River Access site, that does not have a forest zoning. The Trout Farm Road River Access site is currently zoned R-9,600 by Snohomish County, which is defined as single family residential within the urban growth area for the City of Sultan. This site is also within the 100-year flood zone as identified on FEMA's flood insurance rate map (FEMA 1999).

Existing and planned future land use adjacent to the lower Sultan River within the City of Sultan is generally defined as low to moderate density for residential development. There is an area adjacent to the river near Winters Creek that is un-zoned and is expected to be retained in natural conditions. There are also small areas of moderate density residential development and economic development zoning at the very bottom of the Sultan River adjacent to Highway 2 (City of Sultan 2008).

Mitigation and enhancement measures proposed in areas adjacent to the river within the City of Sultan urban growth area would have to be consistent with policies and regulations described in the city's comprehensive plan.

There have recently been changes in the management objectives of other land owners within the upper Sultan River basin, and more changes are planned in the foreseeable future. Due to the mixed land and road ownership within the basin, some of these changes have, or will, modify public access to Project land or facilities. The District is working with other land owners to manage some of these changes described below.

The DNR proposes to abandon and decommission the South Shore Road immediately east of Olney Pass. The DNR recently changed the status of their forest land east of the South Fork of the Sultan River, allocating most of it to Natural Resources Conservation Areas. A proposal to transfer the remaining 3,200 acres of trust land east of the South Fork is before the legislature. The DNR no longer has timber harvesting plans that would generate revenues to maintain the South Shore Road, and furthermore, it would be required by the State Forest Practices Act to upgrade the road at a significant cost. With these changes, it is no longer necessary or desirable for the DNR to maintain this road, and abandoning it could prevent long-term adverse effects to some resources, and protect aquatic resources. The District has an easement from the DNR for the use of this road to access wildlife mitigation land and Project recreation sites. The South Shore Road is also a multi-use road that provides access to DNR land on the south side of Spada Lake, DNR recreation trails east of Spada Lake, and vehicular access to the District's South Fork, South Shore, Nighthawk and Bear Creek day use recreation sites.

Abandoning and converting the South Shore Road immediately east of Olney Pass to a pedestrian-only trail would eliminate vehicular access to the District's recreation sites along the southern shoreline of Spada Lake. This action is not a Project effect, but would affect recreation and land use management at the Project. Additional information is described in Section E.6.7.3.1.1.

In November 2005, the DNR closed the Pilchuck Mainline Road to vehicular travel by the general public northwest of Spada Lake due to increasing environmental and public safety concerns. The road remains accessible to vehicles for DNR administrative uses. The point of closure for this road is approximately 13.5 miles west of the North Shore Recreation Site. Since the District prohibited public access across Culmback Dam after the terrorist events of September 2001, this road closure by the DNR has eliminated public vehicular access to the District's North Shore Recreation Site, and substantially eliminated reasonable access to the site for pedestrians. The distance to the North Shore recreation site from the DNR gate is still feasible for cyclists, but a 27-mile round trip may limit the use of the facility that is designated for day-use only.

E.6.7.3 Proposed Environmental Measures

E.6.7.3.1 Recreation

E.6.7.3.1.1 Develop and Implement a Recreation Resources Management Plan

The following PM&E describes the District's proposal to implement a Recreation Resources Management Plan (RRMP). This plan is provided in Appendix H and is based on the results of a Recreation Needs Analysis (EDAW 2008), as well as consultation with stakeholders. It describes measures proposed by the District to address identified recreation demand, facility modifications needed in response to land management changes in the Spada Lake area, and steps proposed to address the recreation resource issues described in Section E.6.7.2.

Issue

Adequacy of existing Project recreation facilities and public access to meet current and future demand was identified as an issue during Project scoping. The Jackson Project provides valuable recreation amenities in the Sultan River basin. Use of these amenities is affected by watershed restrictions designed to protect the source of municipal drinking water supply. Flow diversions for both hydropower and water supply affect uses in the Sultan River downstream of Culmback Dam.

The effects of vandalism and illegal activities on the quality of recreation experiences and on environmental resources were also identified as an issue during Project scoping. Although not a significant management challenge in most publically accessible portions of the Project area, the isolated setting does attract some inappropriate behavior. The recreation site closest to populated areas, the Trout Farm Road River Access site, experiences the highest level of misuse. No relicensing study directly addressed this issue nor was a specific PM&E measure developed; however, the District proposes to continue addressing this challenge with increased monitoring and site reconfiguration as a component of the RRMP.

Proposed PM&E

The District proposes to implement an RRMP that would encompass all recreation-related PM&Es designed to address scoping issues and other concerns revealed during relicensing consultation. The proposed RRMP would have four components: (1) Recreation Sites and Use Areas Program, (2) Operations and Maintenance Program, (3) Recreation Monitoring and Reporting Program, and (4) Interpretation and Education Program. Program details would be finalized upon license issuance, but the general framework of each program and whether it would address the identified recreation needs is analyzed below. The RRMP supports water quality protection measures required by the City of Everett (e.g., no overnight use, non-contact reservoir-based activities only, no combustion engines, etc.).

Environmental Analysis

No major changes are proposed to Project operations that would affect recreation; however, the typical flow release schedule would be modified to more effectively meet fishery resource needs by providing greater habitat in the Sultan River (process flows). Periodic flow releases are also proposed specifically to help address the demand for whitewater boating in the Sultan River during a 3-year trial period (see Section E.6.7.3.1.2). The District would cease to implement its periodic flow containment measure for winter steelhead anglers (see Section E.6.7.3.1.3).

As mentioned in Section E.6.7.2.2, the DNR intends to abandon the South Shore Road and convert it to a pedestrian trail from Olney Pass to the east. Since the stakeholders would like the District to retain vehicular access to some of its developed recreation sites along the southern shoreline of Spada Lake, the District proposes to take over road maintenance from Olney Pass to the South Shore Recreation Site. This multi-use (both the District and the DNR) 5.2-mile-long road segment would be maintained by the District under an off-license agreement with the DNR. This action would allow continued vehicular access to both the District's South Fork and South Shore recreation sites, as well as to the DNR's South Shore Road trail and trailhead. The DNR's planned trail along South Shore Road would provide the public with pedestrian only access to the District's Nighthawk and Bear Creek recreation sites as well as the DNR's Greider and Boulder recreation areas.

Recreation Sites and Use Areas Program

Based on the results of the Recreation Needs Analysis (EDAW 2008), new recreation facility development is not a high priority need during the new license term given current and anticipated future recreation use levels in the Project area. The District's analysis indicates demand for several activities: walking/hiking, mountain biking, interpretation, and whitewater boating. These activities are currently available in the Project area, but study results indicate that visitor experiences could be improved by providing additional opportunities (Figure E.6.7-1).

Maintaining river access is an important component of the Recreation Sites and Use Areas Program. EDAW (2008) concluded that river access sites are generally sufficient to meet existing and anticipated future recreation needs. Gated road operations would be modified in response to demand for additional vehicle access to the various trails leading to the Sultan River. Other than this, changes to current operation and maintenance practices do not appear to be needed except at the Trout Farm Road River Access Site (addressed below).

The District's proposed Recreation Sites and Use Areas Program (see RRMP, Appendix H) includes conceptual plans and a schedule for recreation development and site modifications. The program also describes mechanisms for reviewing, coordinating and integrating proposed recreation facility construction and modifications with other resource management plans (terrestrial, fisheries, cultural resources, etc.). This PM&E measure includes the following (organized by recreation site/area):

Olney Pass Recreation Site

Olney Pass is the gateway to the Spada Lake area, providing a year round entry kiosk for visitor registration and information, vault toilets, brochures of the recreation sites and a directional sign. Under the proposed RRMP, the District would continue to maintain this site. Updated signage and informational brochures would be developed as part of the proposed Interpretation and Education Program.

South Fork Recreation Site

The South Fork Recreation Site is about 3.0 miles from Olney Pass and offers picnicking, car-top boat launch facilities and vault toilets. Under the RRMP, the District proposes to improve the existing boat ramp to accommodate trailered-boat access and would also provide an improved turn-around area for vehicles with boat trailers. Currently the launch site is useable down to reservoir pool elevation 1,400 feet msl. Proposed improvements would help to accommodate demand resulting from closure of the Nighthawk Recreation Site boat ramp when vehicular access to that site is no longer available. The expanded South Fork boat launch would be open during the WDFW-administered fishing season (typically mid-April through the end of October) and would become the primary boat launch site on Spada Lake.

South Shore Recreation Site and South Shore Road Measures

The South Shore Recreation Site on Spada Lake would be modified under the RRMP. Vehicular access from Olney Pass to the south side of the lake would terminate at this site under a road abandonment plan being pursued by the DNR. Following formal abandonment of the road, DNR proposes to develop a new trailhead at the South Shore Recreation Site or on adjacent lands on the south side of the South Shore Road. The District intends to support the DNR's effort to construct a pedestrian trail to the District's Nighthawk and Bear Creek recreation sites, as well as to popular DNR trails and rock climbing areas in the basin.

Off-license agreements between the District and DNR would be negotiated prior to abandonment of 7.2 miles of the South Shore Road. These agreements would encompass District operation and maintenance of the 5.2-mile road from Olney Pass to the South Shore Recreation Site, DNR development of a trailhead at the South Shore Recreation Site, and construction by DNR of a pedestrian trail to maintain public access to DNR and District recreation areas.

The existing gravel boat ramp at the South Shore site, accessible to reservoir pool elevation 1,415 feet msl, is expected to experience some increase in use with closure of the Nighthawk boat ramp. The District's monitoring program would emphasize additional inspections of this site for several recreation seasons following road abandonment to ensure that parking is adequate for both single vehicles and vehicles with trailers, and other site operations and maintenance actions (e.g., trash collection) are sufficient. In addition to ensuring a high quality experience for visitors, these monitoring actions are particularly important to ensure the continued protection of water quality at the Project.

Nighthawk Recreation Site

Vehicular access to the Nighthawk Recreation Site no longer will be available once the DNR implements its South Shore Road abandonment action. The District proposes to retain some site amenities at Nighthawk, but any facilities adjacent to the lake shore and fire pits would be removed (to reduce water quality impacts and reduce fire hazards). Because access would be significantly restricted for maintenance vehicles, the existing vault toilets may be replaced by a different type of sanitation facility. In addition, the District would remove the concrete boat ramp because vehicles with trailers could no longer reach this site. Disturbed areas would be revegetated with native vegetation that is beneficial to wildlife. Access for District and DNR operations and maintenance is expected to be by all-terrain vehicles (ATV).

Visitor use may decline in the first couple of years after this site has been closed to vehicle access, though use will likely rebound in the future as visitors transition to the change in access. Nighthawk is approximately 0.5 mile from the proposed road terminus at the South Shore Recreation Site, so it could become a short hike destination, potentially attracting families with children. Transitioning to hike-in access would be consistent with the identified demand for more trail opportunities in the basin.

Bear Creek Recreation Site

Access to this viewpoint would also become pedestrian-only once the DNR completes its South Shore Road abandonment. The District proposes to retain the picnic sites and associated amenities, but the restrooms may be removed and replaced with another acceptable sanitation facility. New guardrails would be installed at this overlook site. Access for District operations and maintenance is expected to be by ATV.

As with the Nighthawk Recreation Site, visitor use may decline at first, but would likely rebound as visitors transition to the change in access. Bear Creek would be about a one-mile hike from the proposed road terminus at the South Shore site, so this viewpoint and picnic area could provide a short destination hike. Regular maintenance and monitoring will be an important element of the District’s Operations and Maintenance Program to ensure that potential impacts associated with use changes are identified and rectified in a timely manner.

North Shore Recreation Site

The District’s only recreation development on the north side of Spada Lake has experienced reduced use since the post-September 2001 closure of public access across Culmback Dam. Visitors currently reach this site via bicycle or on foot along the DNR’s PK-ML Road, which is gated 13.5 miles away. As described below (Culmback Dam Access), easier access would be restored under the District’s proposed RRMP.

The North Shore site offers two scenic overlooks with excellent views of Spada Lake, the surrounding mountains and Culmback Dam. Site amenities include picnic areas and vault toilets. Signage and railings would be upgraded by the District. Use is expected to increase with improved access.

Culmback Dam Access Enhancement (North Shore Access Trail)

The District proposes to restore recreation access to the North Shore Recreation Site from the Olney Pass area. The road across Culmback Dam used to be the primary access route to this day use site, but it has been closed to the public since 2001 for security reasons. Under the RRMP, the District would provide controlled access across the dam for pedestrians and cyclists to access the DNR's PK-ML Road which then provides access to the North Shore Recreation Site. Access across the dam would be allowed during daylight hours and could be temporarily halted based on the Department of Homeland Security National Threat Advisory. Public access may also be periodically restricted for other Project security, construction safety, or operational concerns.

Improving access across Culmback Dam would provide a trail-based opportunity to the North Shore site. Visitors could park at Olney Pass (for an approximately 8.0-mile-long round trip hike or bike ride) or at the proposed New Recreation Site described below (for a 5.4-mile round trip). This measure would enable visitors to once again access the North Shore Recreation Site and to experience Culmback Dam, including its interpretive facilities and restrooms.

New Recreation Site

The Recreation Needs Analysis (EDAW 2008) concluded that additional trail opportunities are needed and would enhance recreation experiences in the Project area. In addition, the Recreation Flow Study (Whittaker and Shelby 2008) identified a potential need for improved whitewater boating access. In response to these needs, the District proposes to develop a new recreation site along Culmback Dam Road near the intersection with Forest Road 6122 (Figure E.6.7-1). It would provide a common trailhead for the Culmback Dam Trail and the 6122 Trail (both described below), as well as parking for about 6 vehicles, 2 to 4 picnic sites, bear-proof trash receptacles and interpretive signs. An overflow parking area would be sized to accommodate shuttle vehicles transporting whitewater boaters (and their kayaks) interested in putting in on Segments 1 or 2 of the Sultan River during flow events. The original heated vault toilets near Culmback Dam will be reopened to provide restroom facilities for this new site.

Developing and maintaining a recreation site in this area would provide a formalized location for parking and picnicking for a variety of user groups, particularly hikers, prospectors, whitewater boaters, and mountain bikers. As currently proposed, these users would have to hike or bike approximately 0.5 miles to the Culmback Dam restroom or travel approximately 1.4 miles to facilities at Olney Pass. The site would be developed on District-owned land currently used as wildlife habitat. It would reduce parking pressure on the roadside habitats in the vicinity, particularly at the 6122 Road. The District would maintain a management presence at this new site, which would help limit the potential for unauthorized activities that have been identified elsewhere in the broader Project area.

6122 Road to Trail Conversion

Forest Road 6122 extends from the Culmback Dam Road into timberlands managed by the District and the USFS. The District owns a 0.5-mile-long segment of this road which connects to the segment managed by the USFS. The District proposes to formally abandon its portion of the road, which serves no Project-related purpose other than to provide access to its wildlife lands. The route is used primarily by mining claimants and some whitewater boaters to access a 1.1-mile-long informal trail extending to the upper Sultan River. Because of its deteriorated condition (a landslide blocked a portion of the road in 2003), the USFS does not encourage use of the road or trail by the general public. The USFS assessed this trail and concluded that substantial work would be needed to bring the informal trail up to acceptable standards, and recommended development of an alternate route to the river.

Boaters interested in running the Sultan River typically are able to negotiate the current challenging access, although most would prefer a better trail if it could be provided. Those familiar with the route can carry their boats to the river in less than an hour, but there are challenging sections, including: (1) downed trees and debris across a landslide; (2) several short steep pitches with awkward side-cuts and slippery soils; and (3) a steep drop to the river at trail's end. The USFS planned and budgeted repairs to FR 6122 in 2005, but postponed the effort pending relicensing study results. Current District road upkeep on its 0.5-mile segment includes culvert and ditch maintenance. Access by high-clearance vehicles is possible on this segment and on the USFS segment up to the major landslide.

The District proposes to abandon the 0.5-mile portion of the road crossing its property pursuant to a process defined by the State Forest Practices Act. This action is proposed for several reasons: (1) the road serves no necessary Project purpose; (2) numerous culverts would need to be replaced and a large amount of fill needed to comply with state standards; (3) the District is proposing an alternative river access route for boaters; and (4) relicensing stakeholders requested that some Project area roads be converted to trails.

Because river access currently is affected more directly by conditions on NFS land, the effects of abandonment and trail conversion on recreation use opportunities are expected to be minor.

Culmback Dam Trail

The District proposes to provide access to the Sultan River canyon via a new trail down the face of Culmback Dam. This trail would be available to all visitors, although whitewater boaters are the targeted user group (see Section E.6.7.3.1.2), with this route proposed in lieu of their current access route, the 6122 Road and trail.

The route down the face of the earthfill embankment dam would follow the existing auxiliary release flow line. A grated metal catwalk with handrails would terminate on a flat grassy area at the base of the dam.

The proposed route would provide access to a portion of the Sultan River not previously available. Entering the canyon by this route would offer a unique recreation experience. Visitors not intending to boat the reach most likely would enter and exit the canyon via this trail.

As described in Section E.6.2.1, typically 20 cfs is released at the dam. During high runoff conditions or during the proposed process flow releases (see Section E.6.2.3.2.5) when large volumes of water are being released through the two valves, it is not expected that visitors would choose to use this trail unless intending to boat the river. The District intends to post information about flows at this trailhead to advise visitors of the typical release schedule, allowing them to make informed, personal decisions about the safety of access.

Trout Farm Road River Access Site

The existing Trout Farm Road River Access Site is maintained by the District at RM 2.5. Facilities include a boat launch, parking and a picnic area. As described in the results of the Recreation Needs Study (EDAW 2008), the site is approaching capacity not because of the amount of use it receives but because of the type of use. Recent use patterns have caused ecological and social impacts; therefore, motorized access is restricted to peak use periods and at other times to members of the public who contact the District and request the gate combination. This approach has reduced vandalism, illegal dumping and partying. The District proposes to increase access opportunities and management through the following measures: better defined parking spaces for up to eight vehicles; removing noxious weeds and revegetating with native vegetation attractive to wildlife; removing boulders that inhibit boat launching; improving informational signage; and increasing management presence.

Taking these steps would improve the quality of the recreation experience at this river access site. Clearing encroaching vegetation and formalizing the parking area would make the current spaces more useable, improving parking capacity, and enhancing the appearance of the site.

The City of Sultan suggests that this site should be cooperatively monitored with the City and Snohomish County Sheriff and that security cameras should be installed as a tool to reduce illegal behavior. As recreation use increases over the term of the license, the City also suggests that traffic loads should be monitored to ensure that circulation patterns within the City's Urban Growth Area are not adversely affected. The District's draft RRMP (Appendix H) includes an Operations and Monitoring Program that establishes a schedule for site inspection and maintenance. Because of the proximity of the Trout Farm Road River Access site to population centers, use is expected to be heavier here than at many of the other sites, and therefore the maintenance/site inspection schedule would be more frequent. The District currently has an agreement with the Snohomish County Sheriff's Office to patrol the Project area and anticipates a similar agreement would extend over the term of the new license. These measures should provide adequate oversight of this park.

Powerhouse West River Access Area

At RM 4.3, this site provides parking for about 20 vehicles on the side of Lake Chaplain Road. From here, an informal pedestrian trail extends about 0.5 miles to the river. No changes are proposed to this existing site. The proposed Operations and Maintenance Program includes regular inspection and upkeep of this site.

Powerhouse East River Access Area

This site is also at RM 4.3, but on opposite bank and is reached via the Project Powerhouse and bridge. Under the existing license, this bridge is closed to the public, but to meet increased demand for river access, the District will modify the bridge gate to allow pedestrian entry. The proposed Operations and Maintenance Program includes regular inspection and upkeep of this site.

Old Gaging Station Road River Access Area

This existing Sultan River access site at RM 4.8 shares a parking area with the Powerhouse West Access Area. From this parking area, visitors walk 0.1 miles to the head of this informal trail and then hike 1.0 miles to the river. No changes are proposed to this existing site. The proposed Operations and Maintenance Program includes regular inspection and upkeep of this site.

Horseshoe Bend River Access Area

At RM 6.8, access is provided to the Sultan River from informal parking along the pipeline right-of-way. Several user-defined trails extend a short distance to the National Register-listed Horseshoe Bend reach. No changes are proposed to this existing site. The proposed Operations and Maintenance Program includes regular inspection and upkeep of this site.

Diversion Dam River Access Area

Parking for about 10 vehicles is available at the intersection of the Lake Chaplain Road and the gated Diversion Dam Road. From this point, visitors can traverse the road and access the Sultan River between RM 6.5 and 9.7. The proposed Operations and Maintenance Program includes regular inspection and upkeep of this site.

Use of this reach would be temporarily precluded during construction of the proposed flow discharge structure adjacent to the Diversion Dam Road a short distance downstream of the City's Diversion Dam (RM 9.7). Splicing this 10-foot by 20-foot box-like concrete unit onto the existing concrete flowline is not expected to require more than one or two months of use disruption along this road. When construction is complete, public access would be restored. Information about this planned construction disruption would be posted at the parking area, on the District's web site, and published in the local newspaper so that visitors can make alternate plans.

Recreation Operations and Maintenance Program

An Operations and Maintenance Program (OMP) is included the draft RRMP (Appendix H) that describes the District's responsibilities at Project recreation sites and use areas. Routine maintenance would be provided at the District's developed recreation sites and the various use river access areas. Typical site maintenance standards and frequency are defined.

Reducing illegal activities, identified as a scoping issue, is a challenge to all managers of remotely located public lands. The District combats this by maintaining its recreation sites and use areas. As described in Section E.6.7.2.1.2, recreation areas are patrolled by various parties to curtail illegal activities. The District proposes to continue addressing this challenge with regular maintenance inspections and presence at all developed recreation sites. O&M practices would be enhanced at the Trout Farm Road River Access Site where misuse (including vandalism, trash dumping, resource impacts, and other illicit activities) resulted in limited periods when the site is ungated. During periods of high use, the gate is typically left open unless significant levels of misuse are identified.

Recreation Monitoring and Reporting Program

Under its existing license, the District monitors use of Project recreation facilities through a self-registration system at the Olney Pass Recreation Site entryway. This practice would continue as part of the RRMP's Recreation Monitoring Program. The current program would be expanded to include periodic use level monitoring along the Sultan River and at Lost Lake. Limited monitoring has been conducted of dispersed use areas on Project lands and very few biophysical impacts were identified during relicensing studies. The District proposes to periodically monitor dispersed and lightly developed areas thought to be most susceptible to recreation induced impacts. This effort may be coordinated with terrestrial and aquatic resource monitoring.

The effect of this measure would be a more complete database of information about recreation use levels and impacts that would enhance both site management and FERC-required reporting. Because recreation activities and participation levels change over time, monitoring is necessary to determine if new facilities and/or opportunities should be considered during the new license term. Additionally, recreation activities are constantly evolving and monitoring would determine if unforeseen future activities are compatible with the District's overall resource management objectives.

Specific components of this program include the following:

- The District would periodically monitor recreation use levels in the Project area. Use levels would be monitored at recreation sites at Spada Lake on an annual basis via visitor registration forms obtained at Olney Pass (or another appropriate location).
- Visitor use levels along the Sultan River and Lost Lake would be periodically monitored (to coincide with FERC Form 80 reporting requirements).

- The District would periodically monitor potential impacts from recreation use, focusing on dispersed/lightly developed areas as they tend to be more susceptible to impacts.

Interpretation and Education Program

This proposed program would identify and develop potential themes/topics (e.g., wildlife, fish, history, hydroelectric power generation, drinking water, appropriate recreation behaviors) that may be interpreted in the Project area. Specific locations would be identified to implement these measures, as would appropriate media types (e.g., signs, kiosks, brochures) for these new opportunities.

The intent of this program is to provide information, to use interpretation to enhance the visitor experience, to encourage participation in resource protection measures, and to promote cooperative, safe behaviors to benefit all Project area resources and visitors. Interpretation and conservation education is aimed at helping people recognize and satisfy their responsibilities as citizens for the conservation and stewardship of natural and cultural resources. In addition, the Interpretation and Education program would provide consistent style, content framework and media recommendations that would be followed for all educational and way-finding materials developed for the Project.

E.6.7.3.1.2 Provide Whitewater Boating Opportunities

Issue

Project operations have altered the seasonal flow pattern in the Sultan River by storing winter and spring runoff for power generation, municipal water supply, instream flow augmentation for salmon and trout species, and flood control. The whitewater boating community would like additional flow releases to provide more opportunities to paddle the Sultan River than are currently available.

To address this issue, the District conducted a Flow Recreation Study (Whittaker and Shelby 2008) that assessed whitewater boating in the 16.5 mile Sultan River from Culmback Dam to the Skykomish River. The study evaluated the effects of Project operations on whitewater recreation opportunities and the effects of providing boating flows on other activities such as fishing and mining.

Proposed PM&E

The District proposes to make occasional higher flows available in the Sultan River below Culmback Dam for whitewater boating. Over a 3-year study period, the District would release a total of 900 acre-feet of water to provide whitewater boating flows. A scenario for these releases would be identified in the proposed Whitewater Recreation Plan to be developed within one year of license issuance. This plan proposes to contain a number of provisions that define:

- The frequency, duration, magnitude and timing of releases
- Operational, biological and other release constraints

- Mechanism for release timing that coincides with natural rainfall events or with Project generation to provide greater flow volumes in certain reaches
- Mechanisms for notifying boaters of scheduled boating releases
- Process to assess boater's satisfaction with each release and to assess impacts to aquatic and terrestrial resources
- Methods of recording the number of participants in a release, safety incidents and cost
- Timing constraints to minimize impacts to aquatic resources, potential flooding in the City of Sultan and out of bank flooding
- Methods and schedule to monitor boating flow releases
- A waiver of indemnity for participants in scheduled flow releases.

Environmental Analysis

Controlled flow releases from Culmback Dam affect recreational pursuits in the Sultan River. For example, anglers and prospectors benefit from controlled lower flows, which make the substrate visible and conditions safer for wading and operating equipment. Conversely, these lower flows reduce opportunities for whitewater boating. Advocates for these pursuits and various state and federal recreation agencies concurred that effects of potential flow modifications on these uses should be examined during relicensing; therefore, the District planned and conducted a Flow Recreation Study.

Flow Recreation Study investigations began with interviews of recreation users, including anglers, boaters, watershed patrol officers and others familiar with the effects of flow on recreation uses. This step was followed by a controlled flow assessment, in which 60 boaters reported on their experiences boating reaches of the Sultan River at three different flow levels. Test releases ranged from 185 cfs to 1,400 cfs over a 3-day study period. Preferred flow levels for various boating experiences identified during this study are summarized in Table E.6.7-5.

As a result of these investigations, the District proposes to implement a measure to enhance whitewater boating opportunities and to continue to provide conditions suitable for angling and prospecting.

Boating releases could be made one time each year or there could be a variable number of releases each year. Potentially, boating flow releases could be piggy-backed with operational flows or with releases scheduled for other resources such as the process flows (see Section E.6.2.3.2.5), resulting in a much higher water boating experience. At the conclusion of the 3-year test period, the District proposes to evaluate the trial and may establish a release regime for the remainder of the license term. The District would consult with the whitewater community to assess the boaters' experience during flow releases. This information would be used, along with number of users, safety incidents, costs, and impacts to fish, terrestrial and cultural resources, consideration for other recreation opportunities and enhancements being provided, to make a recommendation to continue, modify or terminate the boating releases. This recommendation would be filed with FERC for review and approval.

Numerous combinations of release options could be analyzed, but for illustrative purposes, we evaluated two different scenarios. First, if boaters requested three equal releases spread over three years, 600 cfs could be released for six hours each year. Under this scenario and the quality of boating experiences identified in Table E.6.7-5, releasing 600 cfs into Segments 2 and 3 would provide an “acceptable” level of technical kayaking flows. “Acceptable” level flows for small rafts in Segment 3 would not be achieved at 600 cfs. In Segment 4, this release would provide “optimal” technical-level flows for kayaks. Conditions in Segment 1 were not assessed. Prospectors and non-boating anglers likely would find these releases too high for their pursuits during the one day that whitewater boating releases are provided each year of the 3-year trial period.

Under a larger flow scenario, 1,000 cfs could be released for approximately five hours on two different days in three years. In Segments 2 and 3, this would provide flows more suitable to the “standard” whitewater boating experience identified in Table E.6.7-5, and would approach a “big water” experience in Segment 2. In Segment 4, this release level would be considered an optimal “standard” whitewater boating trip. Releases of 1,000 cfs could be provided on two consecutive days, in different years, or any possible combination that does not exceed the 900 acre-foot limit. Prospectors and non-boating anglers would find these releases too high for their pursuits during the two days of whitewater boating releases during the three-year trial period.

Boaters also could make use of the proposed periodic process flow releases. As described in Section E.6.2.3.2.5, 22,000 acre-feet would be released over the term of the new license. This equates to 113 hours of maximum outflow from Culmback Dam (through the Howell Bunger valve and the slide valve) of 2,355 cfs. Flows at this level would be considered “big water trips” for kayaks and small rafts (see Table E.6.7-5; Whittaker and Shelby 2008).

The Recreation Flow Study results indicate that boaters generally preferred “optimal” over “acceptable” flows (see Table E.6.7-5), even if releases would be shorter duration or for fewer days (Whittaker and Shelby 2008).

It is challenging to estimate potential use for whitewater boating on river segments where boatable flows are rarely available, but use estimates for potential Sultan River whitewater flows range from about 40 to 200 paddlers, depending upon several factors. Higher use would occur if paddling clubs organize shuttles, releases were well-publicized, vehicle access to the Diversion Dam was offered, there were relatively few days of releases, or releases were available in summer or early fall months. If whitewater boating releases are provided, there are some access challenges related to the Segment 2 put-in and potential access to the Diversion Dam by vehicles.

The District proposes to allow boater shuttle access to both Culmback Dam and the Diversion Dam during planned whitewater boating flow releases. These shuttles would be arranged by American Whitewater and coordinated with District staff. Access (particularly to the Diversion Dam) would be subject to non-hazardous road conditions. Such a shuttle service would reduce logistical considerations for boaters wishing to run Segments 1, 2 or 3 of the Sultan River, increasing the diversity of boating opportunities during the trial releases. The number of boating options would be expanded with respective to run difficulty and time required to complete runs. Boaters would coordinate directly with American Whitewater to arrange these shuttles.

Whitewater boating flow releases could affect fishing and recreational mining between Culmback Dam and the Powerhouse. Fishing in the Sultan River primarily targets steelhead, with the highest use likely in Segment 3 (by wading anglers) and Segment 5 (by boat-based anglers and some by wading anglers). In general, lower flows provide more fishable water and better access. Most wading anglers prefer flows under 200 cfs in Segment 3; potential whitewater boating flows (e.g., over about 600 cfs) would substantially limit the amount of fishable water during the higher flow events. Anglers report a wider fishable range in Segments 4 and 5, where use is mostly boat-based.

Recreational mining occurs in Segments 1 and 3 from March through October and Segment 2 from March through December (this use is most common in July and August). Flows of about 20 cfs in Segments 1 and 2 and less than 100 cfs in Segment 3 are preferred. Any substantial increase in flows (e.g., over 600 cfs for whitewater boating) would preclude mining during the higher flow events. A mechanism for notifying river users and visitors of predicted flow levels would be a component of the District's Whitewater Recreation Plan. Informing boaters and prospectors of flows appropriate to their interests would enable them to maximize benefits from the trial flow regime.

Consistent with the recommendations of the Flow Recreation Study (EDAW 2008), the District would provide year round access to the river at the Powerhouse and would improve boating put-in/take-out at the Trout Farm Road Access Site. The gated 116th Street would remain open during daylight hours to allow greater access to the Sultan River at the Powerhouse. This would improve boater accessibility to Segments 4 and 5 of the river. Additionally, the District would allow pedestrian access across the Powerhouse bridge, improving river access for anglers and boaters. The District may close both the 116th Street gate and/or the Powerhouse bridge based on security or operational concerns. In addition, the District proposes to improve the take-out/put-in area at the Trout Farm Road River Access site at RM 2.5. In conjunction with improved parking and site management, this site would be more suitable for a variety of recreational users.

E.6.7.3.1.3 Spada Lake Recreational Fishery

<u>Issue</u>

Upon completion of Culmback Dam, Spada Lake supported a popular trout fishery. Over the decades, the trout population has declined, as has fishing success. To determine why the fishery is not thriving, the District conducted a trout production study to identify limiting factors and potential enhancement measures (Beauchamp 2008, Meridian Environmental and Shuksan Fisheries Consulting 2008).

Proposed PM&E

Under this PM&E, the District would implement a program to enhance the trout population in Spada Lake and improve recreational access to that population. This measure includes improving boat launches at two recreation sites (described in Section E.6.7.3.1.1: South Fork Recreation Site and South Shore Recreation Site), removing barriers preventing fish passage into Spada Lake tributary streams along portions of the South Shore Road, and developing a brochure describing effective trout fishing techniques, as described in Section E.6.3.3.10. These measures would be refined in consultation with the ARC as the Spada Lake Recreational Fishery Plan is developed.

Environmental Analysis

Trout fishing was very popular in the decade following inundation of the habitat that is now Spada Lake. Fishing success rates were high compared to subsequent decades when population levels declined in tandem with depletion of nutrient levels in the water. As described in Section E.6.3.3.10, because this is a water supply reservoir, steps to enhance nutrients cannot be undertaken; therefore, the District proposes to improve spawning and rearing habitat in an effort to boost this resource.

Improving fishing access to the reservoir at a broader range of elevations would extend the season that anglers with trailered boats could enter the reservoir and would provide a recreation benefit. Because conditions triggering the decline of the trout population cannot be directly mitigated, a lower catch per unit effort compared to historic conditions is expected to be the baseline condition. Educating anglers about the most successful fishing techniques may improve the success rate for some, resulting in a more satisfying recreation experience.

E.6.7.3.2 Land Use

E.6.7.3.2.1 Changes in the Project Boundary

Issue

The District acquired land in the Sultan River basin for the purposes of operating and maintaining Project facilities, providing recreational use or access to Project features, and to mitigate the effects of the Project on wildlife habitat. District land parcels may be contiguous or discontiguous with Project features. Some of these parcels are currently within the Project boundary, while others are not. In order to ensure that the purposes for which District land was acquired is accomplished, FERC generally requires that all land that is necessary for the operation, maintenance, and mitigation of a Project should be included within the Project boundary. During public scoping, no issues associated with the District's ownership of land within the Sultan River basin were identified.

Proposed PM&E

Table E.6.7-6 identifies the proposed changes (additions and deletions) in the Project boundary.

Table E.6.7-6 Proposed Changes in the Project Boundary

Owner / Parcel	Existing Project Area	Added to the Project Area	Subtracted from the Project Area	Proposed Project Area
District	2,143.3	2,277.5		4,420.8
Spada Lake Tract	2,112.9	1,567.7		3,680.6
Lake	1,892.0	16.3		1,908.3
Land	221.3	1,551.1		1,772.4
Recreation Sites	3.5	8.8		12.3
Non-Recreation Sites	217.8	1,542.3		1,760.1
Lost Lake Tract	0.0	213.7		213.7
Lake	0.0	14.2		14.2
Land	0.0	199.6		199.6
Williamson Creek Tract	0.6	480.2		480.8
Project Facilities Tract	27.0	11.4		38.4
Non WHMP / TRMP Tract	2.7	5.0	0.5	7.2
City of Everett	27.3		1.2	26.1
City of Sultan	2.3			2.3
DNR	98.9	7.2		106.1
US Forest Service	10.9			10.9
Private / Undefined	3.4	0.6		4.0

Environmental Analysis

Additions to the Project boundary include the following items that are further described below. The District proposes to add approximately 2,278 acres of District owned land to the FERC Project boundary. Adding this land to the Project boundary would ensure that FERC retains regulatory authority for how it is managed to enhance wildlife habitat, protect aquatic resources, and provide recreational opportunities in the context of source water protection for the primary water supply of a major municipality.

Most of the addition to the Project boundary would occur by adding 1,568 acres of District land to the Spada Lake Tract. This addition would include the approximately 16 acres of Spada Lake, and the approximately 9 acres of recreation sites, that are currently outside of the Project boundary. The remaining 1,542 acres added to the Project boundary is the largest contiguous block of land owned by the District. It is mostly managed for wildlife habitat under the current WHMP, and would be managed under a new TRMP as described in Section E.5.4.3.2. The District is proposing to add all of their land surrounding Spada Lake to the Project boundary. Public access to this land is provided by the Sultan Basin Road at Olney Pass. Only the District land on the south side of Spada Lake is currently accessible by vehicle. Access to land on the north side of Spada Lake is restricted by the closure of the Pilchuck Mainline Road, and the District's access restriction across Culmback Dam (see Section E.6.7.3.2.2). Access to some of the

District land on the south side of Spada Lake is proposed to be changed, as described in Section E.6.7.3.2.2.

A 214-acre District-owned parcel at Lost Lake would be added to the Project boundary. This parcel was purchased by the District in 1988 for wildlife habitat management and to protect it from residential development. The parcel includes a 14-acre lake and 200 acres of land. It is not contiguous with other District land; however, it would be managed under the TRMP to protect wetlands, enhance riparian and upland forest, and improve waterfowl nesting habitat. The District allows only pedestrian recreational access to the Lost Lake parcel. Access can be obtained from DNR land south or west of Lost Lake, with hiking distances ranging from approximately 1.5 to 5 miles. Access through City of Everett-managed property (on the north and east sides) within the hydrologic boundary of Lake Chaplain is prohibited. Including this parcel in the Project boundary would ensure that FERC retains regulatory authority over the District's protection, management, and enhancement of wildlife habitat.

All of the District owned land in the Williamson Creek area would be added to the Project boundary. The District ownership in Williamson Creek totals 481 acres and has been managed by the District for old growth and late seral conifer forest. This parcel is contiguous with the Spada Lake Tract wildlife mitigation land surrounding Spada Lake.

Approximately 11 acres of District owned land would be added to the Project boundary near the Powerhouse (Project Facilities Tract). This is the wedge-shaped parcel owned by the District adjacent to the Powerhouse access road.

A 5-acre parcel of District land encompassing the Trout Farm river access site at RM 2.5 would be added to the Project boundary. This parcel is non-contiguous with other District land and is used both as a put-in and take-out for boaters using the river. Access to this site is provided by a county road (Trout Farm Road) from the City of Sultan. The District controls access to this site with a gate at the property boundary that is open to the public during peak use periods. The District is not proposing to change access to this site. Adding this parcel to the Project boundary would ensure that FERC retains regulatory authority for how this area is managed to provide public access to the river, and to protect the terrestrial and aquatic resources at the site.

Approximately 7 acres of DNR land would be added to the Project boundary. This area encompasses the North Shore and Olney Pass recreation sites. The District has a lease/easement agreement with the DNR for the use and management of these sites. The North Shore recreation site is approximately 2 acres in size, the area defined by the lease/easement agreement with the DNR is approximately 7 acres. The District is not proposing any increase in the area actually used for the recreation site at this location. The Olney Pass recreation site is non-contiguous with District land near Spada Lake. The North Shore Recreation Site is non-contiguous with District land and would be added to the Project boundary as an isolated non-contiguous parcel. This measure would ensure that FERC retains regulatory authority for how these areas are managed to provide recreational opportunities at the Project.

The 0.6 acres listed as being added to the Project boundary under the Private / Undefined ownership category is a result of several minor mapping errors. This area would not be added to the proposed Project boundary. This area is defined by small portions of the mapped areas for the Bear Creek, Nighthawk, and South Fork recreation sites extending beyond the District ownership and proposed FERC boundary adjacent to Spada Lake. These sites are presently on District land, and therefore more detailed mapping would reflect that they would be entirely inside of the proposed Project boundary.

Subtractions to the existing Project boundary are a result of adjustments and errors to the GIS data, and the removal of land that is no longer necessary for Project purposes. These subtractions include the following items and areas. A reduction of the proposed Project area by 0.5 acres is a result of errors and adjustments to the existing GIS mapping data for the District land. This change is entirely a result of different mapping standards and does not reflect a physical change of the Project boundary on the ground. A 1.2 acre parcel owned by the City of Everett is proposed to be removed from the Project boundary. This parcel encompasses the City of Everett Diversion Dam, which is not necessary for Project operations, and would no longer be a feature of the Jackson Project.

The District and the City of Everett (originally as co-licensees) have been jointly implementing the WHMP since it was approved by the FERC in 1989. The WHMP land mitigates for the loss of wildlife habitat resulting from Project development. The current WHMP includes land that is owned separately by the City and the District. In general, City-owned land is around Lake Chaplain, and District-owned land is around Spada Lake. The City-owned land surrounding Lake Chaplain is not within the current FERC Project boundary, although it is managed for wildlife habitat to mitigate for impacts of the Jackson Project. In December 2007, FERC stated that the City need not be a co-licensee for the Project under a new license. As a result of this decision, FERC will no longer have regulatory authority over the actions of the City, and the management of the City-owned WHMP land upon expiration of the current license. In the new license, FERC would require that all wildlife mitigation activities must be under the control of the District, including those activities on City-owned land.

The District and the City propose to continue managing the City's Lake Chaplain land according to the WHMP through the duration of the new license under an off-license agreement. Because the Lake Chaplain land is not owned by the District, the District and City propose to enter into a separate off-license contractual agreement with appropriate stakeholders for the continued management of the Lake Chaplain land under the existing WHMP. The District proposes that the Lake Chaplain land not be included in the Project boundary because it would not be owned or managed by the licensee. The District proposes that the contractual agreement to manage the Lake Chaplain land would commit the City to continue their wildlife mitigation plans through 2060. The WHMP would serve as the primary document describing the management techniques, annual reporting, changes in techniques, and other activities the City would complete on the Lake Chaplain land. Reports documenting the implementation of the mitigation measures and verifying the success of enhancement measures would continue to be prepared and submitted to the signing agencies. The District would continue to prepare and distribute annual reports, schedule and prepare minutes for annual meetings, provide wildlife biologists to coordinate activities at Lake Chaplain, and other activities currently conducted but not contractually required.

Land within the watershed boundary of Lake Chaplain is closed to public access to protect drinking water quality. Land south of the watershed boundary (except the Diversion Dam and the water filtration plant) is open for limited public day use. The existing public access restrictions and opportunities would not change under the off-license agreement for the Lake Chaplain land.

E.6.7.3.2.2 Changes in Access to the Project Land or Facilities

Issue

FERC requires that Project owners control access to Project facilities, either through fee ownership or secured easements. Additionally, Project owners should have control of access to other Project land that provides mitigation for wildlife or recreation to ensure that the owner can fulfill the objectives assigned to that mitigation land. During public scoping, several issues were identified regarding access to Project land. Most of these issues are related to providing, maintaining, or changing existing District controlled access to areas for recreation purposes, and changes in access management by adjacent landowners that impact access to District land and facilities. Public concern about access to Project land and facilities include:

- The proposed loss of motorized access to the South Fork, South Shore, Nighthawk and Bear Creek Day Use sites along the south shoreline of Spada Lake if the DNR abandons the South Shore Road.
- The loss of motorized access to the North Shore Day Use site due to gated closure of the Pilchuck Mainline Road by the DNR.
- The demand for continued tribal access to Project land for traditional cultural purposes.
- The adequacy of the District's public notification procedures for temporary closures and access restrictions to recreation facilities and Project land due to security concerns.
- The demand for improved public access to the Sultan River below Culmback Dam for whitewater boating and recreational prospecting.
- Access to non-operational Project land would continue to be available to tribal members and the public.

Proposed PM&E

South Shore Road

The DNR has proposed to abandon and decommission the South Shore Road immediately east of Olney Pass. The DNR no longer plans logging operations in the basin. With this change, it is no longer necessary or desirable for the DNR to maintain this road, and abandoning it could prevent long-term adverse effects to some resources. The South Shore Road is adjacent to the boundary of District ownership on the south side of Spada Lake. The District has an easement from the DNR for the use of this road to access wildlife mitigation land and Project recreation sites. It is a multi-use road that also provides access to DNR recreation trails east of Spada Lake and to other DNR-managed land on the south side of the lake. The South Shore Road also provides the only vehicular access to the District's recreation sites along the southern shoreline of Spada Lake. This road is entirely outside of the District ownership, with the exception of an approximately 0.5 mile segment along the South Fork Arm of Spada Lake. The District has a cost share agreement with the DNR for the maintenance of this road.

The District will support the abandonment and conversion to a trail of the South Shore Road east of the South Shore Recreation Site by the DNR. An off-license agreement between the District and DNR would be negotiated prior to abandonment of approximately 7.2 miles of the South Shore Road. This agreement would encompass District operation and maintenance of the approximately 5.2-mile segment from Olney Pass to the South Shore Recreation Site, retaining it for vehicle access. Under the agreement, the DNR would develop a trailhead at the South Shore Recreation Site and construct a pedestrian trail to maintain access to existing DNR and District recreation areas east of the road terminus. The trail would be constructed to allow ORV access for the DNR and District administrative use. This measure would change the existing public motorized access to the District's Nighthawk and Bear Creek recreation sites to non-motorized access via the DNR's new South Shore Road trail and is consistent with stakeholder requests for converting some roads to trails.

The District implements restrictions and closures on Project land at various times pursuant to federal security levels. With the changes in access proposed along the South Shore Road, it is important to notify the public of access restrictions that occur throughout the recreation season. As described in Section E.6.7.3.1.1, RRMP, the District proposes to provide informational and directional signage at the Olney Pass to inform the public of changes in recreational facilities, road maintenance, security concerns, and other ongoing activities that require access restrictions to Project land.

Forest Road 6122

The District proposes to abandon their ownership portion (approximately 0.5 mile) of FR 6122 and convert the road to a trail. The trail would be constructed to provide ORV access for mineral claimants, and for Forest Service and District administrative purposes. The District would coordinate the abandonment of the District's portion of the road with the Forest Service. The District proposes this action because their portion of Forest Road 6122 would require significant repairs and upgrades to comply with state forest practices. FR 6122 extends approximately 1 mile (0.5 mile on District and 0.5 mile on NFS land) from the Culmback Dam Road east along the south side of the Sultan River. This road historically provided access to NFS land for several miles along the south side of the Sultan River. A large landslide recently eliminated a segment of this road on NFS land; therefore it now provides vehicular access to only a small parcel of NFS land. The one-mile segment of road that is accessible to motor vehicles provides partial access to a whitewater boating put-in and the mining claim sites on the Sultan River below Culmback Dam. The FR 6122 Road also provides access to the District's wildlife mitigation land; however, the road is not necessary for continued management of this land.

Access to Culmback Dam and the North Shore

The District proposes to allow pedestrian and bicycle access across Culmback Dam for day use. The Culmback Dam road was gated at Olney Pass for security reasons after the terrorist events of September 2001 and has been left open since 2005 as long as the Department of Homeland Security Threat Level remains at yellow or below or other safety measures do not warrant road closure. The road formerly provided access across the dam to the DNR's Pilchuck Mainline Road and the North Shore Recreation Site. Re-opening this route for pedestrian and bicycle access also would facilitate public access to the District's North Shore Recreation Site.

In 2005, the DNR closed the Pilchuck Mainline Road northwest of Spada Lake to all motorized vehicles due to environmental and public safety concerns. The point of closure is approximately 13.5 miles from the North Shore Recreation Site, eliminating all motorized vehicle access to this site and substantially eliminating reasonable access to the site for pedestrians. The distance to the North Shore Recreation Site from the DNR gate is still feasible for bikers, but a 27-mile round trip may limit other types of day use.

The District proposes to change their access restrictions on the Culmback Dam Road to allow pedestrians and bicyclists to cross Culmback Dam. Public access could be restricted in the future upon notice of security or operational restrictions.

Sultan River Access

The District provides public access to several informal river access points along the lower Sultan River that are used for recreation. These access points include the Diversion Dam Road, the Old Gaging Station Road, the Powerhouse, the Horseshoe Bend, and the Trout Farm Road river access sites. The District is proposing enhancements at the Powerhouse and Trout Farm Road River Access Sites (see Section E.6.7.3.1.1). The measures proposed at the Powerhouse site include modifying the bridge gate to allow pedestrian entry. The measures proposed at the Trout Farm Road site includes better defined parking spaces, noxious weed removal, removing boulders that inhibit boat launching, improving informational signage, and increasing management presence.

Tribal Access to Project Land

The District is working with the Tribe on an agreement to provide better access to gated Project land for tribal cultural purposes. This agreement will be off-license per the Tribe's request due to the sensitive nature of cultural practices.

Environmental Analysis

South Shore Road

The District's support for the abandonment and conversion of the South Shore Road to a trail east of the South Shore Recreation Site is consistent with the objective to balance water quality protection with public use opportunities. Converting the road to a trail would reduce the potential for erosion, and the delivery of sediment to Spada Lake, while providing trail-based access to Project recreation sites. This measure would change the existing public motorized access to the District's Nighthawk and Bear Creek recreation sites to non-motorized access via a trail.

Forest Road 6122

The District's proposal to abandon this road is consistent with current forest practice regulations that require minimum road standards to protect public resources. This road would require substantial improvements to meet current forest practices regulations. Converting the road to a trail would reduce the potential for erosion, and the delivery of sediment to streams. The design of the trail to provide ORV access for mineral claimants would meet the objectives of the Forest Service to continue to provide reasonable access to mining claims. The Forest Service is not conducting forest management activities on their land below Culmback Dam, and future timber harvest activities on this land would not be compatible with the Mt. Baker-Snoqualmie National Forest Plan, as amended by the Northwest Forest Plan. The road has also been used by whitewater boaters to access the Sultan River canyon. An alternative access route to the Sultan River canyon would be provided for whitewater boaters via the Culmback Dam trail.

Access to the Culmback Dam and the North Shore

The District's proposal to allow pedestrian and bicycle access across Culmback Dam would re-establish reasonable access to the day use facility at the North Shore Recreation site. The distance from the Culmback Dam gate to the North Shore site is approximately 2.7 miles. This change in access restrictions would likely increase use of the North Shore recreation site compared to existing conditions.

Sultan River Access

Proposed improvements at the Powerhouse and the Trout Farm Road river access sites would provide increased access to Project land and to the Sultan River. Increased management presence at the Trout Farm Road river access site is expected to reduce vandalism, illegal dumping, and partying at the site. This would make the site more friendly to a greater number of recreation users.

Tribal Access to Project Land

The District's proposal to improve access to Project land for tribal members would provide greater opportunities for tribal members to use Project land for cultural purposes.

E.6.8 Aesthetic/Visual Resources

This section describes the aesthetic/visual resources within the Jackson Project boundary and the five WHMP management areas.

E.6.8.1 Affected Environment

E.6.8.1.1 Project Setting

Three major elements in the landscape influence the aesthetic/visual environment: topography, vegetation, and land use/land management. Each element is described below, along with brief descriptions of how the elements influence the aesthetic/visual setting of the Project area.

The Project is located within the Sultan River basin on the west side of the Cascade Mountains. The upper part of the Project (Spada Lake) is situated at approximately elevation 1,450 feet msl and is surrounded by steep mountain ridges rising over 6,000 feet. Spada Lake is located within a broad U-shaped glacial valley fed by steep V-shaped side valleys. Culmback Dam was built at the narrow end of the glacial valley. The 200-foot-deep Sultan River gorge extends below the dam. The first 6 miles of the gorge is especially rugged and narrow and is nearly inaccessible. Below the Diversion Dam, the river continues to flow through steep terrain which loses its gorge character as it gets closer to the Skykomish River. The lower elevation Project areas are characterized as foothills and Puget lowland character types, rolling hills and plateaus that are generally less than 500 feet in elevation.

Vegetation in the Project area is typical of the Western Hemlock coniferous forest zone at lower elevations, and the Silver Fir coniferous forest zone at higher elevations. Logging has resulted in large areas of coniferous regeneration and mid-successional forest, mixed coniferous and deciduous forest stands, and areas of deciduous forest. These directly influence the aesthetic/visual character. While logging has shaped the vegetation patterns, the setting is typical of second growth landscapes throughout the Puget Sound Lowlands. Old-growth forest is restricted to small patches within the Lake Chaplain and Spada Lake tracts, isolated areas along the South Fork of the Sultan River, and on the Williamson Creek Tract.

Timber harvest is one of the primary land uses in the Sultan River basin and on lands visible from the Project. Mining activities in the basin have some effect on the aesthetic/visual environment viewed while fishing or whitewater boating. Because the upper Sultan River basin is in the City of Everett's municipal watershed, recreational development and activities in the basin has been restricted to protect the water quality and the security of the facilities.

E.6.8.1.2 Project Facilities

The following sections briefly describe the existing Project facilities that can be seen by the general public and their visual setting.

E.6.8.1.2.1 Spada Lake

Spada Lake is an irregularly shaped lake that at elevation 1,450 feet msl has approximately 1,908 surface acres and 17.3 miles of shoreline. The overriding aesthetic characteristic of the steep lands adjacent to Spada Lake is of heavily forested slopes terminating in peaks capped by snow for part of the year. Past timber harvest adjacent to the lake is evident. The lake is visible from the District's developed South Shore and North Shore recreation sites (Table E.6.7-1 and Figure E.6.7-1). Project operations uncover and submerge shoreline areas and influence the appearance of the lake perimeter. The normal reservoir pool level fluctuation is approximately 30 to 40 feet. Many of the recreation sites at Spada Lake are closed by the time of maximum reservoir drawdown and the area receives only limited visitation after Labor Day weekend.

E.6.8.1.2.2 Culmback Dam

Culmback Dam is an earth and rock-filled structure that is 640 feet long, 25 feet wide at the crest, and 262 feet above the original streambed. The circular concrete morning glory spillway is located upstream of the dam and has an inside diameter of 38 feet. It is a visible built element in the reservoir. The dam and spillway can be viewed from lower portions of the lake and from some of the recreation sites, such as the North Shore Day Use scenic overlook.

E.6.8.1.2.3 Blue Mountain Tunnel Daylighting Area

This approximately 0.5 acre cleared area is where the four-mile-long tunnel leaves the base of Blue Mountain and becomes the power pipeline. The area is surrounded by chain link fence and barbed wire. It is adjacent to DNR's gated Blue Mountain Mainline road and typically is seen by the public only when trespassing in off-road vehicles around the gate.

E.6.8.1.2.4 Power Pipeline

The approximately four-mile-long power pipeline is buried from Blue Mountain Tunnel to the Powerhouse. A corridor approximately 30 feet wide within the 90-foot-wide ROW above the pipeline is kept free of trees and is mowed and managed for Project operations and wildlife habitat. The cleared ROW can be viewed from several locations on DNR's gated Marsh Creek Mainline and Marsh Creek Mainline-Milepost 1.2 roads.

E.6.8.1.2.5 City of Everett Diversion Dam

The City's Diversion Dam (a current Project facility that will not be a Project component under the new license) spanning the Sultan River is a 120-foot-long, low-level rounded concrete structure that contains a spillway and an associated intake with a metal framework where water is diverted or discharged into a tunnel to/from Portal 2. These built structures are set in a forested steep-walled canyon. As a result, views of the structures are limited to the immediate area, either from the Diversion Dam Road (public pedestrian access to within 400 feet only) or from the river. Whitewater paddlers must either portage around the dam or put in just below it.

E.6.8.1.2.6 Powerhouse and Switchyard

The partially below grade concrete Powerhouse was constructed on the east side of the Sultan River. The concrete roof of the Powerhouse forms a deck for a tall gantry crane. The towers of the adjacent switchyard are another vertical element extending above the Powerhouse. Both facilities are set in a forested area on the Sultan River, where topography and dense tree cover limit views of the facility. They can be seen from the Powerhouse access road, the Powerhouse river access site and while recreating on the river.

E.6.8.1.2.7 Lost Lake Tract

The 230-acre tract is managed by the District as part of the WHMP and contains the 14-acre Lost Lake, associated wetlands, and forested uplands. The area has a natural forested appearance. Due to the dense forest cover and hilly topography, views of Lost Lake are limited to the immediate area of the lake. Hike-in day use access is permitted for wildlife observation, photography, picnicking, hunting, and fishing.

E.6.8.1.3 Project Operations

E.6.8.1.3.1 Spada Lake

Pool level fluctuations caused by Project operations alter the visual character of the Spada Lake shoreline. The reservoir elevation from mid-June through mid-July is approximately 1,445 feet msl. The pool level is lowered during late July through the first half of September to provide municipal water supply for the City, instream flows for the fishery below Culmback Dam, and flood storage for fall runoff. Typically the reservoir pool is lowered approximately 40 feet. Little vegetation grows in the drawdown zone below 1,435 feet msl. This zone is mostly comprised of mud flats and tree stumps, giving a uniform brownish gray appearance around the shoreline margins, depending on the pool level. Between 1,435 and 1,445 feet msl, sparse sedges, rushes, grasses and forbs, and patches of dense wetland vegetation have established in the relatively flat areas. A narrow strip of riparian vegetation frequently grows between 1,445 and 1,450 feet msl, softening the line between land and water.

E.6.8.1.3.2 Sultan River

A portion of the flow diverted at Culmback Dam currently is discharged to the Sultan River approximately 6.5 miles downstream at the City of Everett’s Diversion Dam. The bypass reach between the two dams is not managed by the District, nor is it a Project element within the FERC Project boundary, but its visual character is affected by Project operations. Below Culmback Dam the river has a high gradient and flows through a steep-sided canyon with walls rising from 200 to 800 feet. Under the current license, a year-round minimum flow of 20 cfs is released into the canyon from Culmback Dam and supplemented with tributary inflows that range from 10 to several thousand cfs as measured at the USGS gaging station just downstream of the Diversion Dam. Although during much of the year this amount would be less than natural flows, the area is remote, precipitous, and not easily accessible to the viewing public. Below the Diversion Dam, the minimum flow is maintained at or above 95 cfs from June 16 to September 14 and November 1 to January 15. Historically, natural flows above the Diversion Dam dropped below this level nearly every year, often down to about 50 cfs during the late summer low-flow period. Thus, Project operation has enhanced the visual characteristic of flows during the peak summer viewing period.

E.6.8.2 Project Effects

Because most of the Project is in a remote, mountainous area with rugged forested topography, many of the facilities, including tunnel/pipeline routes and the Powerhouse, are visible to area visitors or residents only when in immediate proximity. One former recreation site that provided direct views of Project facilities from Culmback Dam (known as Site 6) has been inaccessible to the public because of increased security measures adopted in late 2001. Other recreation sites have background views of the dam.

Spada Lake recreation sites are open seasonally between April and November. Peak recreational use occurs between Memorial Day and Labor Day weekends. As a result, the majority of visitors to the Project area do not see the reservoir when it is drawn down for fall and early spring flood control. The timing of the reservoir drawdown thereby limits the visual effects of Project operations on the recreating public.

In the river reach between Culmback Dam and the Powerhouse, current Project effects on aesthetic/visual resources are limited. Public use and access in this reach is limited by the steep canyon topography and densely forested terrain. While river flows are reduced by Project operations, this river reach is not dewatered and is natural appearing.

Several measures are proposed by the District that may be apparent to area visitors. As described in Section E.6.7.3, the road across the top of Culmback Dam would be reopened to the public under the terms of a new license. Dramatic views of Spada Lake and the gorge downstream of the dam once again would be available to visitors traveling by foot or bicycle. This road also provides convenient daylight hour access to the District's North Shore recreation site as well as to the newly proposed stairway/trail leading down the face of the dam into the gorge. This over 200-foot-long trail would be a new visual element on the face of the dam; however, it would parallel an existing 16-inch-diameter pipeline so would not introduce a contrasting linear feature to an otherwise uniform face. Because there are no public viewpoints of the downstream side of the dam, the aesthetic effects of the trail would be minor.

Modifications proposed to the recreation sites and construction of a new site would alter visual conditions, an effect expected to be temporary. The South Shore Road, to be decommissioned by the DNR, would result in pedestrian-only access to the District's Nighthawk and Bear Creek recreation sites. Road decommissioning is proposed to achieve the State's standards for Natural Resource Conservation Areas. As vegetation installed by the DNR recolonizes this corridor, its visual presence will decline. Parking areas at the two affected recreation sites would be revegetated by the District, restoring a more natural appearance over time. Nearer to Culmback Dam, the New Recreation Site would clear sufficient space adjacent to the Culmback Dam Road to accommodate 6 parked vehicles and a small picnic area. Clearing for overflow parking would appear as a widened segment of the road (see Appendix B, sheet 9, of Appendix H). Removing vegetation for this public use area would be visually detrimental, although it is expected to reduce illegal parking on vegetated road shoulders and the visual effects associated with this use.

The new flow discharge structure proposed a short distance downstream of the City's Diversion Dam would add a visual element to this limited access reach of the Sultan River. A 10- by 20-foot box-like structure, about 6.5 feet high, would be spliced into the existing 4.5-foot-diameter concrete pipeline that carries flow from the Diversion Dam to the Lake Chaplain tunnel. A 10-foot-wide, 40-foot-long concrete or rip-rap-lined channel would extend from this structure to the Sultan River, designed to release flows as needed to the river. Riprap placed on both sides of the channel would protect it from high flows. Construction of this new element would require little clearing because the flow pipeline already is present at this maintained site. Construction equipment would use the existing roadbed and would be a temporary visual presence. Permanent vegetation removal for the channel to the river would be apparent to river travelers, although this is expected to have less effect than does the adjacent riprap, a highly unnatural-appearing element. The permanent presence of the new discharge structure would have a minor additional effect on visual resources because of the proximity to the City's Diversion Dam. Public access to this site is pedestrian-only along the existing Diversion Dam Road or by river for those launching boats from the existing 6122 Road or the newly proposed Culmback Dam Trail.

E.6.8.3 Proposed Environmental Measures

Scoping did not identify any aesthetic or visual resource issues or concerns that required technical studies, and the District has not proposed any specific protection, mitigation, or enhancement measures for aesthetic or visual resources. Continued operation of the Project would not be expected to significantly alter the aesthetic character of the setting. Implementation of measures for other resources (e.g., fisheries, recreation, and wildlife) should not affect the existing aesthetic or visual character of the area. As described in Section E.6.7.3.1.1, Proposed New Recreation Site, the District intends to re-open the route across Culmback Dam for non-motorized recreation access. This measure would once again allow the public to experience dramatic views of the Sultan River canyon and Spada Lake. Proposed enhancements to other Project recreation sites would be consistent with the visual character of the area (per design guidelines established in the Recreation Facility Development Program of the RRMP). The existing aesthetic or visual character of the Project area would be maintained through the term of the new license.

E.6.9 Cultural Resources

E.6.9.1 Affected Environment

E.6.9.1.1 Regulatory Framework

Cultural resources include prehistoric and historic-period archaeological sites, historic structures, and traditional cultural properties (TCPs). The latter are places that may or may not have human alterations, but are important to maintaining the cultural identity of a community such as an Indian tribe. The Commission's regulations follow the National Historic Preservation Act (NHPA) of 1966, as amended, in requiring that these resources be inventoried and evaluated for their eligibility for listing in the National Register of Historic Places (National Register); that Project effects be determined; and that consultation take place about mitigation and management measures, and then be presented in a Historic Properties Management Plan (HPMP).

Cultural resources are National Register eligible if they retain integrity and meet one of the four criteria for listing: a) an association with events that have made a significant contribution to the broad pattern of our history; b) an association with the lives of persons significant in our past; c) reflect the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that represent a significant and distinguishable entity whose components may lack individual distinction; or d) have yielded, or may yield, information important to prehistory or history (36 CFR §60.4).

E.6.9.1.2 Cultural Resources Consultation

The District conducted its historic properties study and developed an Historic Properties Management Plan (HPMP, Appendix I) in consultation with potentially affected parties, collectively known as the Cultural Resources Group (CRG). The CRG included the U.S. Forest Service (USFS), Washington State Department of Natural Resources (DNR), the State Historic Preservation Officer (SHPO) which is housed in the Washington Department of Archaeology and Historic Preservation (DAHP), the Tulalip Tribes, Snoqualmie Tribe, Stillaguamish Tribe, City of Everett and Snohomish County.

An abbreviated list of cultural resource consultation efforts (excluding the required ILP meetings) includes:

- FERC issued a Notice on January 30, 2006, designating the District as its non-federal representative carrying out informal consultation pursuant to Section 106 of the National Historic Preservation Act.

- The District sent letters on March 3, 2006, to tribes and on March 15, 2006, to other parties, requesting initiation of consultation.

- The District attended an initial meeting with DAHP on March 14, 2006, regarding potential parties for consultation, area of potential effect (APE) and Project relicensing.

- During the study plan development stage, the District hosted initial CRG meetings on June 19, 2006 and July 17, 2006 regarding the APE, TCPs and study plan development; had two written comment periods on these topics (June 28 and August 2, 2006); met with the Snoqualmie Tribe at their office on July 25, 2006; and met with the Tulalip Tribes at their office on June 26, 2006. DAHP concurred with the APE in their letter dated July 3, 2006 and concurred with the study approach and efforts in their letter dated August 7, 2006.

- During study plan implementation, the District met with the CRG on April 2, August 9, and October 25, 2007, developing an Unanticipated Discovery Plan and discussing the study approach, schedule and results. The District provided a comment review period to the CRG on the draft technical report and Determination of Eligibility forms in January-February 2008; after which, the report was finalized. DAHP concurred with the report's eligibility recommendations in their letter dated June 28, 2008.

- During the Historic Properties Management Plan development, the District provided a review and comment period for the CRG on the draft HPMP in July 2008 and met with the CRG on August 12, 2008. Following this input, the District finalized the HPMP and filed it with FERC.

Additional consultation beyond the meetings and formal comment periods included numerous emails, phone conversations and Project tours.

E.6.9.1.3 Area of Potential Effects

The NHPA requires that the District assess potential Project effects on cultural resources within an area referred to as the Area of Potential Effects (APE). The APE is the geographic area within which an undertaking may directly or indirectly change the character or use of historic properties if any such properties exist (36 CFR800.16 [d]). For Project relicensing, the CRG defined the APE as the:

- Spada Lake drawdown zone from approximately 1,445 feet msl to approximately 1,415 feet msl
- Lands within the Project boundary, excluding the power tunnel (the tunnel lies in solid bedrock hundreds of feet underground)
- Wildlife Habitat Management Plan lands, excluding Lake Chaplain (used solely for City water supply purposes and is not a hydroelectric Project facility)
- Designated recreation sites (at Spada Lake: Olney Pass, South Fork, South Shore, Nighthawk, Bear Creek, Pilchuck Entry and North Shore; and sites along the Sultan River at Horseshoe Bend, Diversion Dam Road, Old Gaging Station, Powerhouse, and Trout Farm Road), including a buffer zone up to 25 feet around the recreation sites
- Access areas to the Sultan River off USFS 6122 Road and Trail, including a buffer zone up to 25 feet on each side of the road and 25 feet on each side of the established trail down to Sultan River, as topography allows
- Diversion Dam Road, including a buffer zone up to 25 feet on each side of the road, as topography allows
- Sultan River from Culmback Dam (RM 16.5) to the Powerhouse (RM 4.3), including a buffer zone up to 10 feet on each side of the river, as topography and safety allow (most of Sultan River is in a narrow, steep-sided gorge).

E.6.9.1.4 Cultural History

Archaeological knowledge about the prehistory of the foothills and slopes of the western Cascade Mountains has revealed evidence of large, complex occupations spanning thousands of years; however, surveys conducted in the Jackson Project area, including investigations for the various development phases of this Project, have yielded little prehistoric material (HRA 2008).

The Native Americans who occupied the Cascade foothills are part of the Puget Sound Salish culture. HRA (2008) presents detail on ethnographic uses of the Project area. No prehistoric archaeological resources have been identified. The topographical and environmental setting of the Sultan River basin has a low probability for containing prehistoric cultural remains. The basin is a drowned river valley with little potential for extensive travel routes; extant prehistoric archaeological resources, if any, would likely be submerged under the reservoir or on ridgelines at the edge of the valley outside the Project APE.

Historical use of the Sultan River basin likely originated with fur trappers and Indian traders who penetrated most of the Pacific Northwest by the 1860s. More intensive use of the area in this period was by the gold miners. Interest in ore deposits along the Sultan River was focused on the 10-mile canyon above Horseshoe Bend. The most ambitious gold mining Project on the lower Sultan was the 800-foot diversion tunnel on the Horseshoe Bend Placer Claim, completed in 1890 by the Sultan River Mining Company. By the early 1880s, quartz mining surpassed gold in importance within the general area, with over 300 locations being worked in the Sultan River drainage. While no single substantial find occurred, sufficient gold and mineral deposits were found to encourage mining activity from the 1860s to the early 20th century. A few small claims are still active on NFS lands downstream of Culmback Dam.

Logging began in the Skykomish Valley around 1860 and advanced slowly upriver. In 1918, the City of Everett tapped the basin for public water supply with a program that included a timber Diversion Dam on the Sultan River and a pipeline extending to the City. In 1930, the City built a new Diversion Dam and a tunnel routing water to Lake Chaplain (Dorpat and McCoy 1998:207 as reported in HRA 2008).

In 1957, the District and City applied for approval to use Sultan River flows to generate electric power, a license to construct the Project was received four years later. Stage I of Culmback Dam was completed in 1965, creating Spada Lake reservoir, providing water storage for the City’s use. When the District raised the dam in 1984 to provide power generation, it constructed the current water conveyance system and Powerhouse. The City’s water supply diversion tunnel now is used to deliver water to Lake Chaplain and to return supplemental fish flows to the river. The 1930 Diversion Dam is now a point of control and measurement for instream flows and remains a vital facility for the City of Everett’s water supply delivery.

E.6.9.1.5 Cultural Resource Surveys

A number of cultural resource studies and informal consultations have been conducted on lands within or near the Project in conjunction with construction of the original Culmback Dam, amendment of the license to add the hydropower facilities, subsequent land exchange actions, and resource management activities associated with relicensing of the Project. This information is described in the PAD, in the Historic Properties Survey Technical Report (HRA 2008) (Study Plan 15), and the studies listed in Table E.6.9-1.

Table E.6.9-1 Cultural resource studies in the APE and general vicinity.

Author(s)	Date	Report Title	Cultural Resources Identified
Kidd	1963	*Sultan Basin Archaeological Project—Final Report on Survey Conducted in 1962-1963*	Cabin remains
Thompson and Lindeman	1979	*Cultural Resource Assessment of the Sultan River Hydroelectric Project*	Possible lithic material, cabin, sluice-water ditch, cabin foundations, railroad grade; 45SN125; 45SN126
FERC	1981	*Final Environmental Impact Statement, Sultan River Project No. 2157*	None
Hicks and Stump	1989	*An Archaeological Reconnaissance of the Proposed Sultan Basin Land Exchange*	MB325, MB326, FS2191, bridge, mine shaft, cedar stumps with springboard notches
USFS	1990	*Determination of Significance and Effect* (Report No. CRR05-89-050, 1371-F-FS-MBS-10)	MB325, MB326, FS2191
Miss and Campbell	1991	*Prehistoric Cultural Resources of Snohomish County, Washington*	Prehistoric archaeological sites (none in general vicinity)
Snohomish County PUD	2000a	*Lost Lake Tract Resource Management Plan*	None
	2000b	*Spada Lake Tract Resource Management Plan*	None
	2001a	*Project Facility Lands Tract Resource Management Plan*	None
	2001b	*Williamson Creek Property Resource Management Plan*	None
Historic Research Associates	2008	*Historic Properties Study for the Henry M. Jackson Hydroelectric Project*	Diversion Dam (1325-1, NR-eligible), Horseshoe Bend (45SN125, NR-listed)

Most of these earlier studies did not address traditional cultural properties. Hicks and Stump (1989:27, as reported in HRA 2008) document a Duwamish Indian tribal informant who reported that his people used the Sultan basin area in late ethnographic times as a spirit quest locale, which may have included camping, hunting, and gathering activities. The District consulted with the Tulalip Tribes in 2000 and 2001 while preparing resource management plans for Project lands and in an effort to identify traditional use information. The Stillaguamish, Snoqualmie and Tulalip Tribes were given opportunities to disclose TCPs during the District's Historic Properties Study; however, no TCPs were disclosed to the District (HRA 2008). In meetings with the District, the Tulalip Tribes indicated that TCPs may be present in undeveloped Project areas behind locked gates, but they have not had sufficient vehicular access to the area to identify such potential resources. Discussions between the District and Tulalip Tribes are ongoing on this matter (March 31, 2009 correspondence from Daryl Williams, Tulalip

Tribes, to Kimberly Bose, FERC) and due to the sensitive nature of the resource have agreed to address access as an off license agreement between the District and the Tribe.

The District undertook an Historic Property Study in 2007 as part of relicensing process. The study plan, APE, sensitivity map criteria, and survey methodology were developed in consultation with the CRG. The field survey was designed to be intensive and take into consideration the survey methods of the Mt Baker-Snoqualmie National Forest. Sampling was to include 100 percent of high probability areas, 40 percent of medium probability areas, and 10 percent of low probability areas. In the drawdown zone, the medium and low probability areas that were safe to access were to be surveyed at 100 percent. Historical Research Associates, Inc. (HRA) tested the expectations derived from the probability criteria and map during archaeological field survey in spring and fall 2007.

No prehistoric archaeological resources were identified during this survey. There is no known history of occupation of the Project area, and there have been no villages found. The Project area is remote and rugged, and it is not likely that anadromous fish provided a food supply in the area above Culmback Dam as there is a natural barrier to anadromous fish downstream of Culmback Dam. The topographical and environmental setting of the Sultan River basin and results of the field survey indicated that the Project area has a low probability for containing prehistoric cultural remains. The basin is a drowned river valley with little potential for extensive travel routes; extant prehistoric archaeological resources, if any, would likely be submerged under the reservoir or on ridgelines at the edge of the valley outside the Project APE. During relicensing meetings with the Tulalip Tribes, the Tribe indicated that the Project setting (plants, animals, water quality) is a cultural resource worthy of protection.

Ten historic-period archaeological resources and one historic-period structure associated with mineral extraction were identified and/or relocated in the APE, reflecting the Sultan River valley's history of mining, logging, and hydrology in the region. Nine of the ten historic-period sites were recommended not eligible for listing in the NRHP due to lack of integrity and/or research potential. One of the sites, the Horseshoe Bend Placer Claim (45SN125), was previously determined eligible for the NRHP. Additionally, one group of associated historic-period structures was identified during the current survey; the Sultan River Diversion Dam and Associated Structures (Field Number 1325-1) was recommended eligible for listing in the NRHP under Criterion A for its historical association with the water supply for the City of Everett and with the broader theme of urban development in Snohomish County. Assessment of potential Project effects to the two identified NRHP-eligible sites (45SN125 and 1325-1) was conducted following receipt of concurrence of site eligibility from the SHPO.

E.6.9.1.6 Recorded Cultural Resources and Historic Properties

This section summarizes information on archaeological sites, historical structures, and traditional cultural properties obtained from DAHP records and cultural resource studies conducted in the vicinity of the Project. This information is summarized in Table E.6.9-2.

E.6.9.1.6.1 Horseshoe Bend Placer Claim

The Horseshoe Bend Placer Claim (Site 45SN125), an historic mining property dating to the 1880s, is located partially inside the APE. The site was previously determined eligible for listing in the NRHP because it has yielded and has the potential to yield information regarding Snohomish County mining history.

The 2007 survey failed to identify several features originally recorded in 1979 because of dense vegetation and no previously unrecorded associated cultural materials were observed. Despite the absence of mining debris, the site still conveys significance because it is the only readily identifiable placer mining site on record in Snohomish County, as well as representing a highly original application of engineering towards existing terrain.

E.6.9.1.6.2 Old Sultan River Dam and Pipeline

Historic photos of the Old Sultan River dam and pipeline, part of the City of Everett's original water supply system, were compared to site conditions during a 2007 survey, revealing that several components of the original system are no longer extant. Remaining features, including the gatehouse structure, the headworks foundation, and a concrete retaining wall, display evidence of moderate to heavy damage. The concrete retaining wall is currently leaning toward the riverbank and will likely collapse in the near future. Several support timbers (beams and wedges) within the tunnels also display evidence of deterioration and are in the early stages of collapse. Additional features such as a concrete support pillar, a concrete abutment, wood trestle beams, and a concrete wall/support structure show similar evidence of heavy deterioration. These features were recorded as Site 45SN430; however, due to lack of integrity of design, materials, workmanship, feeling, and association, this property does not convey the historical importance of its function as Everett's original water system (Criterion A). Based on the background research and analysis of the field investigations, Site 45SN430 does not appear eligible for inclusion in the NRHP under Criterion D due to lack of research potential, in part also a reflection of its lack of integrity.

E.6.1.9.6.3 Sultan Steam Donkey Platform

The Sultan Steam Donkey Platform (Site 45SN431) exhibits evidence of heavy deterioration from weathering and has likely been moved from its location of operation and abandoned at its current position. This site does not appear eligible for inclusion in the NRHP under any of the eligibility criteria due to lack of research potential and site integrity of setting and location.

E.6.1.9.6.4 Startup Gaging Station No. 12137500

The Startup Gaging Station No. 12137500 is historical in age and maintains integrity of location, design, setting, materials, workmanship, feeling, and association. It does not, however, appear to be an individually significant example of construction or function type and is no longer functioning in its historic manner. This gage does not meet Criterion A or B, although it is possible that it may be eligible as part of a multiple property submission of similar facilities in the region (Criterion C), but such an evaluation is beyond the scope of the current Project and unnecessary for Project relicensing, especially since the Project is expected to have no effect on the structures. This gaging station has been designated as Site 45SN432 and Forest Service Site Number 06050600279.

E.6.1.9.6.5 Stringer Bridge

Although the Stringer Bridge (Site 45SN433, Forest Service No. 06050600280) likely meets the age criterion for listing consideration, it does not appear eligible for inclusion in the NRHP under any of the eligibility criteria due to lack of research potential and site integrity.

E.6.1.9.6.6 Sultan CCC Puncheon Road

The Sultan CCC Puncheon Road (Site 45SN434) has been compromised by disturbances such as erosion of the lakeshore terrace as a result of lake level fluctuations. For linear features to be eligible for the NRHP, a substantial part of the resource must retain integrity and make a valuable contribution to our understanding of human history or prehistory. The puncheon road was recommended as not eligible for listing in the NRHP because only a small portion of the original road remains.

E.6.1.9.6.7 South Fork Trail

Disturbances such as shoreline erosion of the lakeshore terrace as a result of lake level fluctuations have compromised site integrity of the South Fork Trail (Site 45SN435). The trail was recommended as not eligible for listing in the NRHP because only a small portion of the original trail remains.

E.6.1.9.6.8 Olney Creek Trail

Disturbances such as erosion of the lakeshore terrace as a result of lake level fluctuations have compromised site integrity of the Olney Creek Trail (Site 45SN436). Because only a small portion of the original trail remains, the trail was recommended as not eligible for listing in the NRHP.

E.6.1.9.6.9 Williamson Creek Road

Erosion of the lakeshore terrace as a result of lake level fluctuations has compromised the integrity of the Williamson Creek Road (Site 45SN437). The road was recommended as not eligible for listing in the NRHP because only a small portion of the original road remains.

E.6.1.9.6.10 South Shore Culvert/Trestle

Preliminary results indicate that the South Shore culvert/trestle recorded as Site 45SN438 is an isolated feature and not eligible for NRHP listing. Should additional features be encountered, the culvert/trestle could be evaluated as a contributing element to a larger archaeological site and potentially considered eligible to the NRHP.

E.6.1.9.6.11 Sultan River Diversion Dam and Associated Structures

The City of Everett's 1930 Diversion Dam, tunnel, and portal structure (Site 1325-1) are located within the APE and continue to function in the same manner as they did when constructed. The portal and tunnel have undergone minor alterations since construction, all of which were necessary maintenance, but this property retains much of its integrity. The property retains integrity of setting, workmanship and function in providing water to the City of Everett. The historic context of these structures is associated with development of the City's water supply system.

E.6.1.9.6.12 Sultan Basin Logging Road Grade and Attendant Structures

Site MB325, located inside the APE on a hillside above the south slope of Spada Lake, was determined not eligible (USFS 1990) and DAHP concurred with the determination.

E.6.1.9.6.13 Olney Pass Puncheon Road Segment

Site MB326 consists of two sections. The first portion is located southwest of Spada Lake; the second segment is northwest of the lake in the Williamson Creek region of the APE. Due to weathering and deterioration, the site was determined not eligible (USFS 1990) and DAHP concurred with the determination.

E.6.1.9.6.14 North Fork Sultan River Puncheon Road and Possible Diversion Dike

Site FS 2191 is located inside the APE near the east end of Spada Lake. The site was determined not eligible (USFS 1990) and DAHP concurred with the determination.

E.6.1.9.6.14 Eligible Historic Properties

Nine of the ten historic-period sites, 45SN430, 45SN431, 45SN432, 45SN433, 45SN434, 45SN435, 45SN436, 45SN437, and 45SN438 were recommended not eligible for listing in the National Register due to lack of integrity and/or research potential. One of the existing sites, the Horseshoe Bend Placer Claim (45SN125), has previously been determined eligible for the National Register. In a letter dated June 27, 2008, the State of Washington Department of Archaeology and Historic Preservation (DAHP) concurred with the recommendation that the nine historic-period sites were not eligible.

Horseshoe Bend Placer Claim

The Horseshoe Bend Placer Claim (45SN125), a historic mining property dating to the 1880s, consists of a tunnel, ditch, and associated features cut through the bedrock of the horseshoe bend of the Sultan River. This site was originally identified in 1979 as part of a cultural resource assessment conducted in conjunction with Jackson Hydroelectric Project improvements (Thompson and Lindeman 1979). In 2007, a pedestrian survey of the exposed banks revealed no artifacts on the ground surface. The opening to the tunnel is completely obstructed by fallen trees and heavy understory. Water inundation prevented a measurement of the entire tunnel length during the 2007 site revisit, but archaeologists were able to access and inspect a portion of the tunnel from a different portal.

The Horseshoe Bend site is located partially inside the APE. The site was previously determined eligible for listing in the NRHP because it has yielded and has the potential to yield information regarding Snohomish County mining history. The 2007 survey failed to identify several features originally recorded in 1979 because of dense vegetation and no previously unrecorded associated cultural materials were observed. Despite the absence of mining debris, the site still conveys significance as being the only readily identifiable placer mining site on record in Snohomish County, as well as representing a highly original application of engineering towards existing terrain.

Sultan River Diversion Dam and Associated Structures

A group of associated historic-period structures was identified within the APE during the 2007 surveys. The Sultan River Diversion Dam and Associated Structures (Field Number 1325-1) was recommended as eligible for listing in the NRHP under Criterion A for its historical association with the water supply for the City of Everett and with the broader theme of urban development in Snohomish County. In its letter of June 27, 2008, the DAHP concurred with the listing recommendation.

Although most of the Project's buildings and structures date to 1984, the City’s 1930 Diversion Dam, tunnel, and portal structure (1325-1) did function as part of the Jackson Project under the current license; and will not be a Project facility under the new license. The City removed the windows and covered a portion of the cladding of the building housing the meters and controls for the Diversion Dam. They updated controls and built a structure above the sluiceway to protect some of the controls from the weather. From the Diversion Dam, a 7,164-foot-long tunnel directs flows from the Sultan River to Lake Chaplain for the City’s water supply. When constructed, concrete lined several hundred feet at either end of the tunnel but the remainder was bare rock. Portals at either end of the tunnel allow workers to access the tunnel.

These structures continue to function in the same manner as they did when constructed. The portal and tunnel have undergone minor alterations since construction, all of which were necessary maintenance, but this property retains integrity of setting as well as its relationship to the surrounding features and open space (the surrounding area remains relatively undisturbed). The workmanship of the structures, and the system as a whole, reveals an application of both technological practices and aesthetic principles. This also contributes to the property's association with the provision of water to the City of Everett.

Sultan River Truss Bridge

One additional historic structure was identified in the area. The Sultan River Truss Bridge was accepted as eligible for the Washington Heritage Register in 1981; however, it was demolished by the DNR in the early 1990s.

Table E.6.9-2 Recorded historic resources in the Jackson Project area

Site Number	Name	NHRP Significance	Date of Determination Status
45SN125	Horseshoe Bend Placer Claim	Listed	5/7/1981
45SN430	Old Sultan River Dam and Pipeline	Determined not Eligible	6/27/2008
45SN431	Sultan Steam Donkey Platform	Determined not Eligible	6/27/2008
45SN432	Startup Gaging Station No. 12137500	Determined not Eligible	6/27/2008
45SN433	Stringer Bridge	Determined not Eligible	6/27/2008
45SN434	Sultan CCC Puncheon Road	Determined not Eligible	6/27/2008
45SN435	South Fork Trail	Determined not Eligible	6/27/2008
45SN436	Olney Creek Trail	Determined not Eligible	6/27/2008
45SN437	Williamson Creek Road	Determined not Eligible	6/27/2008
45SN438	South Shore Culvert/Trestle	Determined not Eligible	6/27/2008
1325-1	Sultan River Diversion Dam and Associated Structures	Eligible (Criterion A)	6/27/2008
MB325	Sultan Basin Logging Road Grade and Attendant Structures	Determined not Eligible	5/10/1990
MB326	Olney Pass Puncheon Road	Determined not Eligible	5/10/1990
FS2191	North Fork Sultan River Puncheon Road and Possible Diversion Dike	Determined not Eligible	5/10/1990

E.6.9.2 Project Effects

Analysis of effects is required for National Register eligible properties identified within the Project APE. Effects commonly identified in reservoir settings include erosion, recreation activities, unauthorized artifact collection and vandalism, and ground-disturbing activities associated with Project operations and maintenance. Effects attributable to the presence, operation, and maintenance of the Project are considered adverse effects to be considered in future management efforts. The effects of the Project on tribal access for traditional cultural practices also were assessed by the District. The District's consultant tested the expectations derived from site probability criteria and Project area maps during archaeological field surveys in the spring and fall of 2007; no prehistoric archaeological resources were identified. If ground-disturbing activities associated with the New Recreation Site and construction of the new Sultan River Discharge Structure reveal previously unidentified cultural resources, the procedures outlined in the HPMP (Appendix I) would be followed.

E.6.9.2.1 Historic Properties

Two historic properties have been identified in the Project APE, the Diversion Dam (Field Number 1325-1) and the Horseshoe Bend Placer Claim (Site 45SN125). The City of Everett's Diversion Dam and Associated Structures is National Register eligible. It is a component of the City of Everett's water system; it is the back-up diversion facility to supply Lake Chaplain with water when the hydroelectric facilities are non-operational. Because the Diversion Dam is an important operational component of the water supply system, it is maintained in good working order. No ongoing adverse Project effects have been identified for this facility; future monitoring should occur by the City to verify no ongoing effects that could undermine the qualities of the property that make it National Register-eligible.

The Horseshoe Bend Placer Claim is located well away from Project features and is not affected by ongoing Project operations. Potential effects to this resource are from recreation activities. Activities in the vicinity of the placer claim include hiking, kayaking, and fishing. Recreationists can inadvertently contribute to site deterioration by climbing on structures, using structures for recreational activity support (e.g., tying climbing ropes, soil disturbance at undesignated entry and takeout locations) and dumping garbage.

E.6.9.2.2 Traditional Cultural Properties and Tribal Access to Project Lands

The District recognizes the importance of federal recognition, treaty rights, and traditional cultural properties to affected tribes. Consultation was undertaken with three interested tribes, the SHPO and the USFS to identify information about traditional uses in the Project area. The Tulalip Tribes are federally recognized and have off-reservation, treaty-reserved fishing, hunting, or gathering rights in the Project area. The Snohomish, Skykomish, Snoqualmie, and other tribes were merged together during treaty times (circa 1855) to form the Tulalip Tribes. Portions of the Snoqualmie Tribe that chose not to become part of the Tulalip Tribes received federal recognition in 1999. Based on literature research, the Stillaguamish and Snoqualmie tribes may have culturally-related interests in discrete locations in the Project area (HRA 2008). By letter dated August 3, 2005, the Stillaguamish Tribe informed the District that “there are no concerns from the Tribe at this time”. Because the Snoqualmie Tribe’s aboriginal territory included the Snoqualmie River (a branch of the Snohomish River), some tribal members may have some traditional cultural places in the Project vicinity. To date no specific treaty-reserved rights with regard to off-reservation fishing, hunting, and/or gathering have been identified by the Snoqualmie Tribe. The District met with the Tulalip Tribes on several occasions to discuss access to the Project area for cultural purposes. Due to the sensitive nature of such uses, the Tulalip Tribes preferred to handle access to the Project area as an off-license agreement rather than through the FERC process.

E.6.9.3 Proposed Environmental Measures

E.6.9.3.1 Implement an Historic Properties Management Plan

Issue

The National Historic Preservation Act of 1966 requires that the effects of a federally licensed Project on National Register-eligible cultural resources be identified and measures to protect and manage these resources presented in an Historic Properties Management Plan (HPMP). Accordingly, the District conducted cultural resource surveys and prepared an HPMP in consultation with potentially affected parties and the CRG.

Proposed PM&E

The District requests that the Commission issue a license article that requires implementation of the District's HPMP. The HPMP is attached as Appendix I to this Final License Application.

Environmental Analysis

The purpose of the HPMP is to minimize the potential effects of the Project on cultural resources by providing guidelines for evaluating, monitoring, managing and avoiding potential effects, and determining specific actions to address affects on known or yet to be discovered sites in the Project area. The HPMP's general management measures require the District to: (1) identify an Historic Preservation Coordinator (HPC); (2) maintain confidentiality of sensitive cultural information; (3) provide ongoing consultation with cultural resource representatives; (4) develop annual reports; (5) train Project personnel on cultural resources and historic properties management; (6) develop surveying strategies detailing what activities are exempt from additional surveys and the process to evaluate activities that are not exempt from archaeology surveys; (7) monitor eligible sites; (8) develop Diversion Dam Maintenance Guidelines to guide the City's routine maintenance of this historic property; (9) implement an Unanticipated Discovery Plan; and (10) develop protocols to be undertaken during emergency situations. The District will implement the HPMP in accordance with the following schedule (Table E.6.9-3):

Table E.6.9-3 Schedule for implementing cultural resources management measures

Measure	Frequency	Deadline
Conduct Project staff training	Every two years	First Quarter
Monitor recorded historic sites	Site 45SN125 will be monitored annually by HPC; if changes observed, a professional archaeologist will update site form and route to parties. Other sites as determined.	In tandem with other Project activities or when site(s) is exposed
Conduct additional archaeological survey of APE	As needed for planned Project activities	As needed
Review/revise measures in the HPMP	Every 5 years at minimum	Every 5 years
Consultation Meetings	As needed	As needed
Annual Report	Yearly	March 1

E.6.10 Socioeconomic Resources

E.6.10.1 Affected Environment

The following section summarizes information that was presented in the PAD (Snohomish County PUD and City of Everett 2005) to describe socioeconomic conditions in the Project area and has not been updated to reflect current socioeconomic conditions which have not changed dramatically. As discussed in detail in the PAD, data related to the land use, demography, and economy of Snohomish County and its cities portray an area split between an urban and rural character, with a manufacturing-based economy hard hit by the economic downturn at the beginning of the decade. Areas of the county which were previously dependent upon natural resources have remained somewhat economically depressed, except where they have become bedroom communities for the larger cities. Overall, improvements in the local economy have occurred recently, with significant new commercial developments in the Marysville area and measured increases in manufacturing, but the county has not returned to the relative economic prosperity experienced in the late-1990s.

Urban uses are concentrated in the western portion of the county, largely focused around the I-5 corridor. The cities of Everett, Lynnwood, and Marysville are all located within this corridor. In the county's urban growth areas, land is essentially equally split between incorporated and unincorporated. East of the I-5 corridor, a large amount of land (approximately 975,000 acres) is reserved for natural resource-based activities, including farm and forest land. A large portion of this land is used for commercial and state forestry. Federal land (including National Forest) comprises another significant component of resource lands. Overall, this division creates a differentiation in lifestyle and economic base between the eastern and western portions of the county.

At 644,800, Snohomish County is the third most populous county in the state. The county's population has been growing faster than the state as a whole (6.4 percent growth compared to 4.6 percent growth at the state level) since 2000. Over the last 30 years, population and housing construction have consistently increased in the county, with both increasing over 25 percent in all three decades. The county's largest population center and county seat is the City of Everett, with an estimated population of 96,480 in 2004 (sixth largest city in the state). The Jackson Project provides both water (80 percent of the water supply) and electricity (5 percent of the electrical supply) to Snohomish County residents.

Due to the relatively remote location of the Project, only four cities are located within a 15-mile radius. These cities include Sultan, Gold Bar, Monroe, and Index. Of these, Monroe is the only city with over 5,000 residents. The Project's significance from a socioeconomic perspective appears to be due to a number of factors. These include providing: (1) a reliable, quality water supply supporting business and residential growth in urban and growing areas of the county; (2) a reliable source of electric energy, benefiting primarily eastern Snohomish County; and (3) recreation opportunities.

Demographic characteristics within the county are relatively consistent. As a result of a range of factors, a number of communities have experienced significant growth in both total population and housing units in the last decade. Much of this growth has occurred since 2000. In all of the jurisdictions of Snohomish County, white residents make up the large majority of the population, with minority populations making up no more than 19 percent of any community. Average household size showed some variation between jurisdictions, but household size was consistently larger than the state total in all of the featured jurisdictions. Consequently, children comprised at least 25 percent of all of the communities.

Education levels were also generally consistent across jurisdictions. Two exceptions to this similarity were identified. Both household income and poverty rates varied significantly, with the City of Everett ranking lower in median household income and higher in poverty rates when compared to other cities. These data did not significantly deviate from totals at the state level and thus do not represent a disproportionate number of low income residents within the city.

Finally, employment and labor force trends show a natural resource and manufacturing-based economy on the rebound from the stagnation over the past five years. The Boeing Company, with its manufacturing facility in Everett, continues to be the largest employer in the county with over 7 percent of total employees (24,700 employees in 2000). Boeing's prominent role created significant impacts on the local economy over the last five years. The September 11, 2001 terrorist events substantially reduced the demand for Boeing's products, and the company laid-off approximately 12,000 employees in the Puget Sound region. This staffing reduction substantially increased unemployment in the county and the city. Unemployment in most cities of Snohomish County remains higher than the state as a whole, although this is improving. Notably, preliminary estimates of 2004 unemployment in Everett show a rate of 11.8 percent. This large unemployment rate is much higher than 2004 estimates for the entire county. In contrast to the City of Everett, the county's unemployment rate decreased substantially between 2003 and 2004.

E.6.10.2 Project Effects

The Jackson Project provides valuable water and energy resources for both incorporated cities and rural portions of Snohomish County. Current Project operations provide approximately 5 percent of the electric power and 80 percent of the water used by residents of Snohomish County.

Within the county, specific cities and towns, including the Tulalip Tribes and its 1,500-acre commercial development (Quil Ceda Village), receive substantial benefits, in the form of high-quality, reliable power and water resources from the Project. The heavily urbanized areas of the county, extending along and on either side of the I-5 corridor, are increasingly reliant upon water supplied through the Project. It appears that the benefits of the Project are shared by the county as a whole, and that its impacts do not disproportionately affect any group. Therefore, environmental justice does not appear to represent a vital concern for the Jackson Project relicensing process.

While Jackson Project electricity has been more expensive than most regular alternative sources of supply, the Project has provided reliable service in eastern Snohomish County. From time to time it has also helped to buffer the District against volatile market prices, which may rise significantly to reflect demand and availability.

E.6.10.3 Proposed Environmental Measures

Issue

No socioeconomic issues were identified during scoping or during subsequent environmental analysis.

Proposed PM&E

The District is not proposing any PM&Es that specifically target socioeconomic conditions.

Environmental Analysis

Although the District is not proposing specific socioeconomic PM&Es, relicensing the Project would affect socioeconomic conditions. Continued power generation and water supply would provide a reliable base for economic recovery in Snohomish County, and provide energy from a clean, renewable resource. Implementation of measures that protect water quality, improve fish and wildlife habitat, and enhance boating access, trail access, and day-use sites would benefit local communities through their effects on quality of life, and would increase recreational opportunities within the region.

E.7 DEVELOPMENTAL ANALYSIS

E.7.1 Power and Economic Benefits

The Jackson Hydroelectric Project (Project) generates on average 421,800 MWh's of power annually at the current City of Everett water supply demand of 84 mgd. All power produced is sold to District customers. Issuance of a new license would provide a beneficial, dependable, economic, and clean source of electrical energy for many years into the future. The renewable energy generated annually at the Project would avoid the purchase of power from the northwest wholesale market which is a mix of renewable and non-renewable sources.

Forecast Mid-Columbia prices are the market for wholesale power rates in the Pacific Northwest. These prices range from $44.89 per MWh in 2010 to $55.38 per MWh in 2018.

The annual cost of operating the Project over the past six years (FY 2003 to FY 2008) has been approximately $31,888,702 per year (Table E.7.1-1).

Table E.7.1-1 Annual Project Costs, 2003-2008

	Year (Actuals)					
Expenses	2003	2004	2005	2006	2007	2008
Operations & Maintenance	$ 3,682,503	$ 2,709,785	$ 3,468,990	$ 3,120,333	$ 4,420,762	$ 2,725,790
Taxes	$ 87,279	$ 87,636	$ 64,898	$ 89,146	$ 2,463,408	$ 497,904
Relicensing	$ 109,679	$ 360,231	$ 1,135,535	$ 1,036,828	$2,199,069	$ 1,755,844
Interest on Long Term Debt	$10,497,037	$10,290,435	$ 9,672,497	$ 8,993,626	$ 9,406,151	$ 9,417,586
Principle Repayment	$11,864,583	$12,130,417	$12,737,500	$13,370,833	$14,042,917	$14,741,250
Depreciation	$ 3,975,620	$ 3,984,427	$ 3,992,398	$ 4,023,789	$ 4,086,244	$ 4,089,284
Total Project Cost	$30,216,701	$29,562,931	$31,071,818	$30,634,555	$36,618,551	$33,227,659

This value includes operations and maintenance, taxes, capital expenses, relicensing and debt service. Future operating costs are expected to escalate with inflation. Short-term increases in capital cost are possible associated with major equipment failure and replacement or repair. No significant major maintenance or equipment replacements are anticipated for the initial years of the new license period. However, major upgrades are anticipated during the course of the next license which will likely be financed through the issuance of bonds. The current debt service payments will be completed by 2020 as the current Project bonds are retired.

If the Project is not relicensed to the District, operational benefits (power generation, flood management) and Protection Mitigation and Enhancement measures including benefits to ESA-listed fish and wildlife and recreational flows would be foregone.

E.7.2 Cost of Environmental Measures

The estimated cost of implementing the District's proposed PM&Es is shown in Table E.7.2-1, below. Cost estimates provided for capital construction projects were developed using a combination of actual material cost quotes, unit cost quantities from bid results of previous public works projects, and cost estimates reported by consultants, as well as estimated costs for permitting and fees, design services, inspection, and internal staffing costs as appropriate for a planning level budget. The detailed back-up for the costs presented were assembled and reviewed by professional engineers working for the District, and are available upon request.

Cost estimates provided for reports, and required plans including professional services are based upon planning-level budgets provided by the District's various consultants. This cost includes the estimated cost of the consultant to write the report, as well as District's time and resources for review and managing the various studies and plans.

Table E.7.2-1 Estimated costs of protection, mitigation and enhancement measures.

Description	Capital Costs 2009 Dollars[1]	Average Annual O&M Costs	Anticipated Year of Implementation
Operations / Operating Plan			
Control Max Flow During Salmon Spawning	$ -	$-	
Instream Flows[2]	$ -	$-	
Process Flow Release Plan	$ 75,000	$-	2012
Process Flows[3,4]	$ -	$ 24,000	
Pelton Turbine Flow Continuation System	$3,500,000	$ 2,000	2009
Aquatic Resources			
Prepare Woody Debris Management Plan	$ 40,000	$-	2011, 2012
Large Woody Debris	$2,400,000	$ 10,000	2013, 2014
Side Channel Enhancement Plan	$ 75,000	$-	2012
Sultan River Side Channel- Create New Habitat[5]			
Sultan River Side Channel- Ensure Connectivity[5]	$1,600,000	$ 20,000	2011, 2012
Smolt Planting	$ -	$ 30,000	
Water Temperature Conditioning and Management Plan	$ 50,000	$-	2012
Temperature Control Valving	$ 100,000	$ 1,000	2011
Maintain River Temperature within Stage I Range	$ -	$ 5,000	
Prepare Water Quality Protection and Monitoring Plan	$ 80,000	$-	2011
Conduct Annual Water Quality Monitoring	$ 30,000	$ 20,000	2011
Monitor Salmon and Steelhead Escapement	$ 10,000	$ 25,000	2011
Aquatic Resource Committee	$ -	$ 20,000	
USGS Gage Maintenance	$ -	$ 50,000	
Operations and Aquatic Resources Subtotal	$7,960,000	$207,000	
Terrestrial Resources			
Terrestrial Resource Management Plan [9]		$160,000	
Noxious Weed Management (years 1-5)	$ 520,000		2011-2016
Noxious Weed Management (years 6-50)	$ -	$ 70,000	
Terrestrial Resources Subtotal	$ 520,000	$230,000	
Rare, Threatened and Endangered Species			
Marbled Murrelet Habitat Protection Plan	$ -	$ 7,000	
Recreation Resources			
Whitewater Flows (3-years)[3,6]	$ -	$ 17,000	2012-2014
Whitewater Recreation Plan	$ 40,000		2011

Description		Capital Costs 2009 Dollars[1]	Average Annual O&M Costs	Anticipated Year of Implementation
	Spada Lake Recreation Fisheries Plan	$ 35,000		2012
	Spada Lake Fishery Enhancements	$ 150,000	$ 5,000	2013
	Road Improvements: Olney Pass to Site 3	$ 560,000	$ 36,000	2013
	Olney Pass Recreation Site	$ -	$ 5,000	2013
	South Fork Recreation Site	$ 200,000	$ 5,000	2013
	DNR Rd Abandonment Coord beyond Site 3	$ 246,000	$ 1,000	2013
	Nighthawk Recreation Site	$ 100,000	$ 5,000	2013
	Bear Creek Recreation Site	$ 38,000	$ 5,000	2013
	New Recreation Site	$ 320,000	$ 5,000	2013
	Culmback Dam Trail	$ 80,000	$ 1,000	2011
	6122 Road Abandonment / ORV Trail[7]	$ 100,000	$ 1,000	2012
	Dam Security Lighting and Fencing	$ 260,000	$ 13,000	2012
	North Shore Recreation Site	$ 82,000	$ 5,000	2013
	Trout Farm Road River Access	$ 75,000	$ 5,000	2013
	Pedestrian Gate at Powerhouse Waterline Bridge	$ 10,000		2012
	Recreation IEP	$ 100,000	$ 5,000	2012
	Recreation Resources Subtotal	$2,396,000	$114,000	
Cultural Resources				
	Historic Properties Management Planning		$ 16,000	
	Total Proposed PM&E Costs	$10,876,000	$574,000	
	Relicensing Costs to Date[8]	$8,000,000		

1. Capital costs assume a 5% rate of inflation of construction prices.
2. Costs are the same relative to the current operation.
3. Cost of flows assumes this volume of water would be unavailable to the Pelton units yet would displace flow in the Francis units.
4. Cost is expressed as the total cost of the volume of release divided by the fifty years in the anticipated license.
5. Because the construction tasks are integral; connectivity and habitat are expressed with total costs as one line item.
6. Cost is expressed as the total cost of the volume of release (900 AC-FT) divided by the three years in the trial period.
7. Costs are limited to portion of improvement which is on District lands.
8. Costs to date include work by consultants for the PAD, studies, PLP, FLA, and District labor, training and equipment expenses
9. Terrestrial Resource Management Plan costs do not include lost opportunity cost for harvesting.

E.8 COMPREHENSIVE DEVELOPMENT ANALYSIS

E.8.1 Costs and Benefits of Proposed Environmental Measures

The electric power generated at the Jackson Project avoids the need to develop or use an equal amount of fossil fuel-fired electric generation and capacity, conserving non-renewable resources and reducing atmospheric pollution. In addition to these benefits, the District's proposed action includes a suite of PM&Es that are intended to address each of the issues identified during the scoping process. These PM&Es cover water quality, aquatic resources, wildlife habitat, noxious weeds, listed species, recreation, and cultural resources. Costs for each PM&E are presented above in Table E.7.2-1. Although these measures add to the cost of operating the Jackson Project, the District concludes that the benefit of each measure outweighs its cost. The basis for this conclusion is presented below for each resource area.

Water Quality

The District is proposing to implement two new PM&Es to ensure continued protection of water quality within the Project vicinity over the course of a new license term. These two PM&Es include an overarching water quality plan and a water temperature conditioning measure in OR-3. The water quality plan would consist of annual water quality monitoring and management activities to guarantee continued protection of water quality and to ensure compliance with existing state water quality standards. The temperature conditioning measure would condition the water temperatures released at Culmback Dam to enhance the temperature regime for aquatic resources in OR-3. The District also proposes to continue water temperature conditioning to match pre-Stage II temperatures in OR-1 and OR-2 as occurs under existing conditions. Mimicking the pre-Stage II water temperature regime downstream of the new discharge structure would continue to protect fish use designations, and help maintain abundant salmon and steelhead populations in the lower Sultan River.

The estimated capital cost of the water quality PM&Es is $260,000, and the estimated annual cost is $26,000. We consider the expected benefits of protecting water quality and conditioning water temperatures (including expected benefits to federally listed fish species) to be worth the cost of developing and implementing these measures.

Aquatic Resources

The District is proposing an array of PM&Es that would improve habitat conditions for aquatic resources in the Sultan River, including fish and macroinvertebrates. Establishment of an ARC would provide a mechanism for coordinating these activities, and modifying them as needed. The District would continue to monitor annual escapement of steelhead and Chinook, pink and chum salmon; results of the spawning surveys would be useful in evaluating the effectiveness of aquatic resource PM&Es.

The District proposes to implement several flow-related measures. Revised reservoir rule curves are intended to ensure that water is available for these purposes. Provision of higher minimum instream flows and process flows would increase the area of spawning habitat for many species, restore connectivity to side channels, and prevent redds from being dewatered during the critical incubation period. Revised downramping rates and installation of a governor control system at the Powerhouse would also help to prevent stranding and potential redd dewatering. While periodic channel forming flows would not be likely to remove riparian vegetation that has already encroached into the Sultan River channel, it would be likely to reduce further encroachment. Provision of juvenile outmigration and adult upstream migration flows would assist fish in moving through the Sultan River system.

The District is also proposing to implement PM&Es to improve specific aspects of aquatic habitat. These include a Side Channel Enhancement Plan to improve side channel connectivity, and a Large Woody Debris Plan to increase aquatic habitat complexity.

The District is proposing two measures that are intended to enhance public angling opportunities. These include continued funding for annual planting of steelhead smolts in the Snohomish basin to mitigate for lost production above the City's Diversion Dam; and implementation of a plan to improve the Spada Lake fishery. The plan would address boating access to the lake and provide information about fishing opportunities, as well as monitoring trout spawning in tributaries and native and hatchery trout genetics.

Aquatic resource PM&Es are expected to provide substantial benefits at an estimated capital cost of $7,960,000 and annual cost of $207,000.

Terrestrial Resources

Implementation of the TRMP would provide long-term benefits for wetlands, riparian areas, and old-growth and late-successional forest, and for the wildlife species associated with these habitat types. The TRMP specifies enhancement methods for lake, wetland and stream buffers, snags and decaying live trees, coarse woody debris, right-of-way management, and nesting waterfowl, and provides a mechanism for monitoring and reporting. It includes measures to protect old-growth forest and accelerate the development of old-growth characteristics in younger stands, both of which would contribute to cumulative benefits in the Sultan River basin. The TRMP addresses the need for on-going wildlife mitigation under the current Project license and mitigation of minor adverse effects that would result from implementation of the proposed PM&Es for operations, fisheries, and recreation. For these reasons, the implementation of the plan warrants the estimated annual cost of $160,000.

Implementation of the Noxious Weed Management Plan would consolidate the District's current approach to weed management and provide a systematic approach to weed management and monitoring on Project lands and areas that may be affected by Project operation or Project-related activities. It would also help to protect native plant communities, including those that support plants and wildlife of cultural importance to the Tulalip Tribes. The benefits of implementing this plan outweigh the estimated capital cost of $520,000, with annual costs of $230,000.

Recreation Resources

The District's proposed Recreation Resources Management Plan would provide a comprehensive approach to planning, managing, maintaining, and monitoring recreation resources for the Project, including the construction of two new recreation facilities and maintenance and enhancement of existing sites. Implementation of this plan would allow the District to efficiently meet current and future recreation needs. At two of the existing recreation sites (South Fork and South Shore), improved boat access is linked to the Spada Lake Recreational Fishery Plan mentioned above, and would extend the season boaters could use the reservoir.

The District also proposes to develop a Whitewater Recreation Plan to evaluate opportunities and constraints associated with releasing occasional high flows to support whitewater boating in the Sultan River below Culmback Dam. Implementation of these high flow releases would enhance existing opportunities.

The estimated capital cost of recreation PM&Es is $2,396,000, and the estimated annual cost is $114,000.

Rare, Threatened and Endangered Species

With the exception of PM&Es that target the recreational fishery in Spada Lake, all of the District's proposed aquatic resource measures are expected to benefit listed Chinook salmon and steelhead. Implementation of these PM&Es would address several of the pathway indicators that suggest adverse Project effects on fish habitat in the Sultan River, such as warm water temperatures, low abundance of large woody debris, riparian vegetation encroachment into the river channel, disconnection with side channels and floodplain habitat, and ramping events. Availability of spawning and juvenile rearing habitat for Chinook and steelhead would not change substantially with implementation of the new minimum flow releases, but higher flows would substantially improve the availability of side channel habitat needed to support these species. Implementation of the Side Channel Enhancement Plan would provide further benefits for listed species, as well as other salmonids.

Implementation of the District's proposed Marbled Murrelet Habitat Protection and Management Plan would prevent the inadvertent loss of nest trees to routine Project operations and maintenance, forest management activities, or development of new recreation facilities. It would also minimize the risk of noise disturbance to nesting birds. Without this plan, Project-related activities could adversely affect this listed species. We conclude that the benefits of implementing this plan outweigh the estimated annual cost of $7,000.

Cultural Resources

The District is proposing to implement an HPMP (Appendix I) that would provide guidelines for evaluating and avoiding potential adverse effects on cultural resources that could occur during routine Project operations and maintenance or during implementation of PM&Es for fisheries, wildlife habitat, noxious weed management, and recreation. The HPMP would ensure a coordinated approach to training of Project personnel, consulting with cultural resource representatives, and long-term management and monitoring of existing sites and protection for handling previously undiscovered sites. Without this plan, there would be a risk of inadvertent damage or loss of cultural resources. For this reason, the benefits of implementing this plan warrant the estimated annual cost of $16,000.

E.8.2 Unavoidable Adverse Effects

Based on the analysis presented in Section E.6, we identified unavoidable adverse effects in four resource areas. Unavoidable adverse effects are those that would occur as a result of the proposed action, even with implementation of the proposed PM&Es.

Water Resources

Due to the nature of hydroelectric Project operations, coupled with the need to meet the City's water supply requirements and to provide incidental flood control, the reservoir would continue to fluctuate to a greater degree than a similarly situated natural lake system.

Aquatic Resources

Unavoidable adverse effects associated with the continued operation of the Jackson Project may potentially include the loss of relatively few rainbow and cutthroat trout through entrainment/impingement at the Project intake, and the continued modification of natural flow and sediment transport regime in the lower Sultan River. The expected loss of fish through entrainment is unlikely to have a population level effect on this resource, and the proposed enhancement measures for fish and aquatic resources included in the District's proposed PM&Es are anticipated to be more beneficial than under the current license.

Terrestrial Resources

Construction of a new flow discharge structure, new recreation site, and new recreation trails would cause minor, short-term, localized noise disturbance, and wildlife would likely avoid these areas during construction. Forest management activities would cause periodic, localized noise disturbance, as well. Over the long term, wildlife disturbance due to recreation activity would increase in some areas and decrease in others.

Approximately 20 acres of lake fringe wetlands have developed along the Spada Lake shoreline since the Project was constructed; reservoir operations in dry years could have a small effect on these plant communities. Reservoir fluctuations would continue to prevent development of a perennial riparian plant community along much of the shoreline.

Recreation

Project operations would continue to limit the availability of free-flowing riverine recreation opportunities in the Sultan River. Implementing flow-related PM&Es would periodically increase water surface levels between Culmback Dam and the Diversion Dam, adversely affecting recreational mining in the river.

E.9 CONSISTENCY WITH COMPREHENSIVE PLANS

The District identified 19 comprehensive plans that have been filed with FERC and that have relevance to the Jackson Project. The assessment presented in this section identifies each of these plans and how the Project would or would not be consistent with each.

USDI Bureau of Land Management and USDA Forest Service. 1994. Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. Washington, D.C. April 13, 1994.

These guidelines were established under an ecosystem-based approach to managing Forest Service and BLM lands in order to create healthy ecosystems with functioning habitats for native species. Compliance with these standards and guidelines are intended to constitute the Forest Service and BLM's contribution to the recovery of the northern spotted owl. The standards are separated for designated areas into congressionally reserved areas, late-successional reserves, adaptive management areas, managed late-successional areas, administratively withdrawn areas, riparian reserves, and a matrix encompassing all areas.

The USFWS has designated critical habitat in a network of mapped owl conservation areas (MOCAs) to aid in the recovery of northern spotted owl on federal lands, six MOCAs are located in Snohomish County. Critical habitat nearest the Jackson Project is located approximately 1 mile outside the Project near Williamson Creek. The Mt. Baker-Snoqualmie National Forest manages these lands according to standards and guidelines contained in the Northwest Forest Plan for Late Successional Reserves and Late Successional Old-Growth Areas (USFS and BLM 1994). The Washington State Forest Practice Rules apply to management of northern spotted owls on non-federal lands in Washington, including District lands. The DNR manages owl habitat on State ownership through its federal Habitat Conservation Plan (DNR 1997). Three spotted owl surveys were completed for the Project area in 2007 and again in 2008. No spotted owls were detected in either year.

USDA Forest Service. 1990. Mt. Baker-Snoqualmie National Forest land and resource management plan. Department of Agriculture, Seattle, Washington. June 1990. 396 pp.

The Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan was adopted in June 1990 and amended in April 1994. The 1994 amendment incorporates the Record of Decision based on the U.S. Forest Service and Bureau of Land Management planning documents for federal forest lands within the range of the northern spotted owl. The Record of Decision and the associated management standards and guidelines direct the USFS to implement ecosystem management within the subject areas. The MBSF Plan states that the Sultan River watershed will be managed under the terms of the 1963 Memorandum of Understanding between the Forest Service, the City of Everett, and the District. Management emphasizes watershed protection, recreation use at developed sites (no water contact sports), timber production, and maintenance of fish and wildlife habitat. Dispersed recreation is permitted, but not encouraged.

The Project area is managed to comply with these guidelines. The area provides trails, campgrounds and lakeside parks as described in Section 6.7, Recreation and Land Use. Because Spada Lake is a municipal supply watershed, uses in the vicinity are restricted to protect water quality pursuant to the terms of a 1963 MOU with the City of Everett. Operation of the Project is managed to protect fish and wildlife as discussed in Sections E.6.3 and Section E.6.4, respectively.

Interagency Committee for Outdoor Recreation. 2002. An assessment of outdoor recreation in Washington State: A State Comprehensive Outdoor Recreation Planning (SCORP). Document 2002-2007. Olympia, Washington. October 2002.

The Interagency Committee for Outdoor Recreation’s (IAC, now the Recreation and Conservation Office, or RCO) assessment of Washington’s outdoor activity found that walking, cycling and team or individual sports are the most popular statewide. Most walking and cycling activity is done close to home on sidewalks, streets and roads, and it is unclear whether participants prefer these locations to a more natural setting. Activities such as hunting and fishing are also popular and require natural surroundings. In the plan, the IAC recommends that hydropower project operators “enhance inventory with trails and paths for walking and bicycling, manage disperse shoreline camping, improve access for on-water recreation, and improve opportunities for nonconsumptive interaction with nature including fish and wildlife.”

Spada Lake and the surrounding Project area offer miles of trails and 35 picnic sites. Spada Lake currently provides three boat launches; however, this would be reduced to two launches under the terms of the new license. Two of the District’s parks are within a state-designated Natural Resources Conservation Area, in which motorized access is prohibited and therefore would be converted to hike-in access and also eliminating one boat ramp. The Project would continue to provide recreation opportunities that address some of the demand identified by the IAC. More detail on recreation in the Project area can be found in Section E.6.7.

Interagency Committee for Outdoor Recreation. 1995. State of Washington outdoor recreation and habitat: Assessment and policy plan 1995-2001. Tumwater, Washington. November 1995.

The State of Washington Outdoor Recreation and Habitat Assessment and Policy Plan updates a plan for the acquisition, renovation, and development of recreational resources and the preservation and conservation of open space. The plan identifies walking, running/jogging, visiting zoos and fairs, bicycling, and mountain bicycling as the top five popular activities at the time of publication and the top five activities expected to grow between 1995 and 2001 as walking, bicycling, participating in field sports, golfing, and camping. Goals are set for the acquisition and development of public resources and analyzes whether recreation providers are meeting and demand for resources. The Jackson Project continues to provide access to open spaces and areas for recreational activities. The Project has more than 20 acres developed for recreation uses, and Project roads provide access to hundreds of acres for informal recreational use.

Interagency Committee for Outdoor Recreation. 1991. Washington State trails plan: policy and action document. Tumwater, Washington. June 1991.

This plan acknowledges that there is an increasing need for trails in Washington State. In 1987 approximately 76 percent of Washington residents said that they walk or hike for recreation; 26 percent use off-road vehicles for recreation. The plan describes five goals to meet the increasing need for trails: (1) develop new trails and paths in city and county jurisdictions, (2) connect trail systems and populated areas via trails and paths, (3) reduce state and federal trail maintenance backlogs, (4) increase the miles of trail available in semi-primitive and other remote settings, and (5) strengthen existing funding sources and create new funding sources for trail maintenance, construction, and reconstruction. Issues brought up in the plan include access, capacities, communication, economics and funding, a state trail network, maintenance, multiple-use trails and management, natural resources, private lands, railroad right-of-way, use compatibility, utility corridors, volunteers, and water trails. The plan presents 27 actions as potential solutions that may be used as management objectives rather than specific development scenarios.

The Jackson Project contributes to the objectives of "increase the miles of trail available." Within the Project area, several road segments would be converted to trails and a key access route would be reopened to the public. The District proposes to convert a segment of the 6122 Road on its property to a trail for pedestrians and ORVs. The road traversing Culmback Dam, closed since September 11, 2001, would be reopened for non-motorized use, restoring access from the south side of the Sultan River to the District's North Shore recreation site and to hiking/biking trails beyond. On the south side of Spada Lake, the DNR intends to convert a segment of the South Shore Road to a pedestrian-only trail beyond the District's South Shore Recreation Site. Hike-in access to the District's Nighthawk and Bear Creek sites would contribute to the regional demand for additional trails. Additional information on these measures is presented in Section E.6-7.

National Park Service. 1982. The nationwide rivers inventory. Department of the Interior, Washington, D.C. January 1982.

The nationwide rivers inventory lists rivers or segments of rivers that are free-flowing and have "outstandingly remarkable" natural or cultural values judged to be of more than local significance. Rivers are judged on the criteria of Scenery, Recreation, Geology, Fish, Wildlife, Prehistory, History, Cultural, and Other Values. The Sultan River is not listed on the nationwide rivers inventory.

Northwest Power and Conservation Council. 2005. The fifth northwest electric power and conservation plan. Portland, Oregon. Council Document 2005-07.

The plan describes the historic trend in increasing demand for electricity. The Northwest Power and Conservation Council (NPCC, or Council) helps the region make critical decisions about the power generated by the federal power supply system and to balance that demand without undue effects on fish and wildlife. The plan discusses the costs and benefits of various types of power, from wind to hydroelectric, and sets goals for the power production for each. The Council recommends actions in the following categories: conservation, demand response, generation, transmission, resource adequacy, fish and wildlife, monitoring, and future actions of the BPA. Continued operation of the Jackson Project would contribute to the supply of electricity in the northwest and would be consistent with the NPCC's other regional goals.

Northwest Power Planning Council. 1988. Protected areas amendments and response to comments. Portland, Oregon. Council Document 88-22 (September 14, 1988).

The Northwest Power Act of 1980 (Act) required the NPCC to develop an electric power plan for the entire Northwest. The Act called for the development of resources that would be both cost-effective and environmentally acceptable. Some river reaches have been designated as protected areas where the Council believes hydroelectric development would have an unacceptable risk of loss to fish and wildlife species of concern. NPCC's recommendations on licensing of projects are taken into account by FERC, but do not apply to existing facilities that have already been licensed or the relicensing of such a facility. The Jackson Project is not located in a protected area and was licensed prior to the inception of this Act.

U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

This plan serves as a guide for public and private organizations in the United States and Canada for the conservation and management of waterfowl. Twenty nine species of ducks, three species of geese including 18 subspecies and races, and four species of swans are considered to be waterfowl under the plan. Subsistence and recreational harvest of waterfowl is allowable under this plan. The aim of the habitat program outlined in the plan is to maintain and manage an appropriate distribution and diversity of high quality waterfowl habitat in North America that will (1) maintain current distributions of waterfowl populations, and (2) under average environmental conditions, sustain an abundance of waterfowl consistent with goals listed in the plan.

The WHMP for the Jackson Project manages migratory and non-migratory waterfowl along with other wildlife species that use the lands within the Project area. The WHMP complies with the outline set out by the North American waterfowl management plan and does not violate any individual species management plans. The proposed TRMP would also be consistent with this plan.

U.S. Fish and Wildlife Service. Undated. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

The USFWS recreational fisheries policy is dedicated to optimizing the opportunities for people to enjoy the nation's recreational fisheries, ensuring the future quality and quantity of fisheries, and working in partnership with other Federal governmental agencies, states, tribes, conservation organizations, and the public to effectively manage these resources. The policy has four goals: (1) effect the preservation and/or increased productivity of fishery resources; (2) ensure and enhance the quality, quantity, and diversity of recreational fishing opportunities, (3) develop and enhance partnerships between governments and the private sector for conserving and managing recreational fisheries; and (4) cooperate to maintain a healthy recreational fisheries industry.

While recreational salmon fishing within the Project area is limited to reaches below Culmback Dam, fishing for trout and other non-anadromous species is common on Spada Lake. Project operations are managed to benefit fish in the Sultan River and contribute to salmon and steelhead populations that may be subject to fishing pressure further downstream. The Jackson Project is consistent with the objectives of this policy.

Washington Department of Community Development. Office of Archaeology and Historic Preservation. 1987. Resource protection planning process – Paleoindian study unit. Olympia, Washington. 55 pp.

The PaleoIndian Study Unit is a prehistoric resource study unit established to identify, evaluate, and protect archaeological resources throughout Washington. The Resource Protection Planning Process document summarizes knowledge of archaeological resources extending from initial human occupation of Washington to an arbitrary date of 7,500 years before present. The Study Unit encompasses the entire state, as archaeological finds from the period have been found throughout Washington. Historical use of the Project area likely originated with fur trappers and Indian traders before the 1860s; other use of the area during this period and later was by gold miners. Surveys conducted in the Project area have yielded little prehistoric material. No known archaeological resources have been identified that require protection.

Washington Department of Ecology. 1979. Snohomish River Basin instream resources protection program. Olympia, Washington. August 28, 1979.

In order to preserve Snohomish River basin instream resources during low flow conditions (mainly during late summer and fall), Ecology proposed instream flow levels for all streams in the basin. Diversions are only permitted so long as base flows can be met. Critical levels were based on the Ecology's methods for determining flows. The Project abides by instream flow regulations specified by Ecology for various operation stages to protect the resources of the Sultan River.

Washington Department of Ecology. 1994. State wetlands integration strategy. Olympia, Washington. December 1994. 80 pp.

Ecology and the Department of Community Trade and Economic Development jointly developed the State Wetlands Integration Strategy to develop and implement a move effective, efficient, and coordinated system for protecting Washington's wetland resources. The program is funded by a grant from the EPA and includes two separate components: (1) local government demonstration projects; and (2) policy work groups. The six policy work groups developed 47 recommendations that require the development of legislation and/or administrative rules and government implementation activities to provide for more integrated wetlands protection. An Interagency Wetlands Review Board is responsible for ensuring that policy recommendations are implemented.

Extensive wetland surveys have been conducted within the Project boundary following the state criteria. The Project would continue to be managed to preserve these wetlands, as described in Section E.6.5.

Washington Department of Fisheries. 1987. Hydroelectric project assessment guidelines. Olympia, Washington. 91 pp.

These guidelines were developed to present the management goals of the Washington Department of Fisheries (now WDFW) regarding hydropower development. It provides an outline for conducting studies to gather the information needed to assess the potential impacts of a project on fish and wildlife. The guidelines require the identification of anadromous and resident fish and wildlife issues related to the project and the steps needed to protect species of concern. Through consultation with WDFW and the relicensing processes, this Project would be consistent with these guidelines.

Washington Department of Game. 1987. Strategies for Washington's wildlife. Olympia, Washington. May 1987.

This strategy was developed to protect wildlife resources, focusing on the protection of many wildlife species, and seeking to establish and conserve the highest quality habitat. The strategies are to require adequate fish passage at dams; maintain and increase sustainable wild trout populations; and establish instream flows to protect fish and wildlife. Some of the species of fish and wildlife addressed in this plan are present in the

Jackson Project vicinity. Current and proposed management objectives for these species can be found in Sections E.6.3 and E.6.4.

Washington Department of Natural Resources. 1987. State of Washington natural heritage plan. Olympia, Washington. 108 pp.
(Note: We were unable to locate this edition; the 2007 version was used.)

Required by the 1981 amendment to the Natural Area Preserves Act, the State of Washington Natural Heritage Plan guides the implementation of the Natural Heritage Program. The purpose of the plan is to identify priority plant and animal species and ecosystems to be considered in the selection of potential natural areas and the criteria and process by which natural areas are selected. The plan outlines a ranking system to classify both species and ecosystem rarity in the state and globally to determine the level of protection a specific element should receive. Six land use designations are recognized as contributing to the statewide system of natural areas: Natural Area Preserves, Natural Resources Conservation Areas, Areas of Critical Environmental Concern, Biological Study Areas, and sites on the Washington Register of Natural Places.

The Jackson Project is located in the North Cascades ecoregion. Approximately 26,000 acres of DNR-managed land to the north, east, and the south of Spada Lake were added to adjacent Natural Resources Conservation Area lands to form the Morning Star NRCA. Rare, threatened, and endangered species in the Project area are described in Section 6.6 of this document. The District adheres to management protocols to protect and benefit each of the listed species on Project lands.

Washington Department of Natural Resources. 1997. Final habitat conservation plan. Olympia, Washington. September 1997.

The Habitat Conservation Plan addresses the long-term management of over 1.6 million acres of forested State of Washington trust lands within the range of the northern spotted owl. The habitat conservation plan was developed to comply with the federal Endangered Species Act and provides the basis for the USFWS and the NMFS to issue Incidental Take Permits for legal forest management activities on the applicable state lands. Critical habitat lands near the Project are managed by the Mt. Baker-Snoqualmie National Forest and the DNR manages owl habitat in the Project area through this Habitat Conservation Plan.

Washington State Energy Office. 1992. Washington State hydropower development/resource protection plan. Olympia, Washington. December 1992. 34 pp.

The Washington State Hydropower Development/Resource Protection Plan was the state's first comprehensive hydropower plan. The plan was developed in accordance with the Electric Consumers Protection Act of 1986 and was adopted in 1992 by the Washington State Energy Office. The plan applies only to new hydropower development at sites that do not have existing hydropower generation. Facilities that meet the following conditions are exempt from the plan: facilities generating power, including facilities undergoing relicensing, and projects where the applicant has completed, at a minimum, the first stage consultation requirements in the FERC licensing process. As the Jackson Project was already generating power at the time the Plan was adopted, the Project is exempt.

Washington State Parks and Recreation Commission. 1988. Washington State scenic river assessment. Olympia, Washington. September 1988. 70 pp. and the scenic rivers program – report. Olympia, Washington. January 29, 1988. 8 pp.

The Sultan River is not listed as part of the State Scenic River System. The statute RCW 79.72 establishes certain criteria that must be met to list additional river segments; the Sultan River does not meet these criteria. The first criterion is that the river must be "free-flowing without diversions that hinder recreational use." As long as the Jackson Project operates with an impoundment on this system, these criteria will prevent the Sultan River from being eligible.

The Washington State Scenic River Assessment identifies 18 rivers that the Washington State Parks and Recreation Commission believes worthy of consideration as additions to the Scenic Rivers System. The Sultan River is not included as one of the 18.

The Scenic Rivers Program Report is an explanation of the Scenic Rivers Program. There is an explanation of the Program's authority and a list of rivers determined to be eligible for submission to the Program. This list is the same as the 18 rivers recommended for listing in the Scenic River Assessment discussed above and does not contain the Sultan River.

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