PRE-APPLICATION DOCUMENT

SKAGIT RIVER HYDROELECTRIC PROJECT
FERC NO. 553

Prepared by:

Seattle City Light

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TABLE OF CONTENTS

List of Appendices

List of Figures

List of Tables

List of Acronyms and Abbreviations

°C ....degrees Celsius
°F.............................degrees Fahrenheit
µg/L.........................micrograms per liter
7-DADMax ....maximum 7-day average of daily maximum temperature
ACHP........................Advisory Council on Historic Preservation
ADA..........................Americans with Disabilities Act
AIR...........................Additional Information Request
AIRFA.......................American Indian Religious Freedom Act
AIS ....aquatic invasive species
AISMP ....Aquatic Invasive Species Management Plan
AISU ....Aquatic Invasive Species Unit
APE..........................area of potential effect
ARMMP...................Archaeological Resources Mitigation and Management Plan
ARPA........................Archaeological Resources Protection Act
Bd.............................*Batrachochytrium dendrobatidis*
BIA...........................Bureau of Indian Affairs
BLM..........................Bureau of Land Management
BMI..........................benthic macroinvertebrate
BMP..........................best management practice
BPA...........................Bonneville Power Administration
CERCLA...................Comprehensive Environmental Response, Compensation, and Liability Act
CFR..........................Code of Federal Regulations
cfs.............................cubic feet per second
CFU..........................colony-forming units
CIP ....Capital Improvement Plan
City Light..................Seattle City Light
cm.............................centimeter
CMA ....Climbing Management Area
COOP........................Cooperative Observer Program
CPP ....Countywide Planning Policies

CPROS.......................County Parks, Recreation and Open Space
CPUE ....catch per unit effort
CRWG........................Cultural Resources Work Group
DAHP.........................Department of Archaeology and Historic Preservation
dbh.............................diameter at breast height
DIP ....demographically independent population
DLA ....Draft License Application
DNR ....Department of Natural Resources (Washington State)
DPS ....distinct population segment
EAP ....Early Action Program
Ecology ....Washington Department of Ecology
eDNA ....environmental DNA
EFH ....essential fish habitat
ELC ....Environmental Learning Center
ENSO ....El Niño–Southern Oscillation
EPA ....Environmental Protection Agency
ESA ....Endangered Species Act
ESH ....effective spawning habitat
ESU ....Evolutionarily Significant Unit
FCC ....Flow Plan Coordinating Committee
FEMA ....Federal Emergency Management Agency
FERC..........................Federal Energy Regulatory Commission
First Nations...............Indigenous Peoples of Canada
FLA ....Final License Application
FMP...........................fisheries management plan
FPA ....Federal Power Act
FPC ....Federal Power Commission
FR...............................Federal Register
FSA ....Fisheries Settlement Agreement
ft ....feet
ft/mi...........................feet per mile
FTEC..........................fish tissue equivalent concentration
GIS ....Geographic Information System

GMA ....Growth Management Act
GMP...........................General Management Plan
GMU ....Game Management Unit
GPP ....General Policy Plan
GPS ....Global Positioning System
HABS.........................Historic American Building Survey
HAER.........................Historic American Engineering Record
hp................................horsepower
HRMMP.....................Historic Resources Mitigation and Management Plan
IBP ....Institute for Bird Populations
ILP..............................Integrated Licensing Process
IPP..............................Invasive Plant Program
ISR ....Initial Study Report
km ....kilometer
kV...............................kilovolt
KVA...........................Key Viewing Areas
kWh............................kilowatt hour
LAG ....Land Acquisition Group
LEED ....Leadership in Energy and Environmental Design
LIDAR ....Light Detection and Ranging
LP...............................licensing participant
LRMP.........................Land and Resource Management Plan
LWD ....large woody debris
m ....meter
mg/L...........................milligram/liter
MIS ....Management Indicator Species
mL..............................milliliter
MOA ....Memorandum of Agreement
MP..............................milepost
MPG...........................major population group
MPN...........................most probable number
MPP............................Multicounty Planning Policies
MSA...........................Magnuson-Stevens Fishery Conservation and Management Act

msl.............................mean sea level
MW ....megawatt
MWh ....megawatt hour
NAGPRA ....Native American Graves Protection and Repatriation Act
NAIOP ....National Association of Industrial and Office Properties
NAVD 88 ....North American Vertical Datum of 1988
NCC ....Non-flow Coordinating Committee
NCCC.........................North Cascades Conservation Council
NCI.............................North Cascades Institute
NEPA ....National Environmental Policy Act
NERC.........................North American Reliability Council
NGO...........................non-governmental organization
NHPA.........................National Historic Preservation Act
NHR ....National Historic Register
NISIMS ....National Invasive Species Information Management System
NMFS.........................National Marine Fisheries Service
NOAA ....National Oceanic and Atmospheric Association
NOI ....Notice of Intent
NPS ....National Park Service
NR..............................National Register (of Historic Places)
NRB ....National Register Bulletin
NRCS ....National Resource Conservation Service
NRHP.........................National Register of Historic Places
NRI.............................Nationwide Rivers Inventory
NTU ....nephelometric turbidity unit
OBIA..........................Object-based Image Analysis
O&M..........................operations and maintenance
PAD............................Pre-Application Document
PBF ....physical and biological feature
PCT ....Pacific Crest Trail
PDO............................Pacific Decadal Oscillation
PFMC.........................Pacific Fishery Management Council
PHS ....Priority Habitat and Species

PLP............................Preliminary Licensing Proposal

PME ....protection, mitigation, and enhancement

PNT............................Pacific Northwest National Scenic Trail

Project ....Skagit River Hydroelectric Project

PSE.............................Puget Sound Energy

PSP.............................Proposed Study Plan

PURPA.......................Public Utility Regulatory Policies Act of 1978

RCW ....Revised Code of Washington

RIVPACS...................River Invertebrate Prediction and Classification System

RLNRA ....Ross Lake National Recreation Area

RM ....river mile

ROW ....right-of-way

RPM ....revolutions per minute

RSP ....Revised Study Plan

RTE............................rare, threatened, and endangered

RWG ....Resource Work Group

SCDDP.......................Skagit County Dike District Partnership

SCORP.......................State Comprehensive Outdoor Recreation Planning

SD ....standard deviation

SD1 ....Scoping Document 1

SD2 ....Scoping Document 2

SDIDC........................Skagit Drainage and Irrigation District Consortium

SEEC..........................Skagit Environmental Endowment Commission

SFEG..........................Skagit Fisheries Enhancement Group

SHPO ....State Historic Preservation Officer

SOI.............................The Secretary of the Interior

SOIS...........................The Secretary of the Interior's Standards for the Treatment of Historic Properties

SPL.............................sound pressure level

sq. mi..........................square miles

SR...............................State Route

SRMP.........................Skagit Wild and Scenic River Management Plan

SRSC..........................Skagit River System Cooperative

State NWCB..............Washington State Noxious Weed Control Board
SWE ....snow-water equivalent
TCL ....traditional cultural landscape
TCP ....traditional cultural property
TDG ....total dissolved gas
THPO ....Tribal Historic Preservation Officer
TMDL ....Total Maximum Daily Load
TNC............................The Nature Conservancy
U&A...........................usual and accustomed
USACE ......................U.S. Army Corps of Engineers
U.S.C..........................United States Code
USCB .........................U.S. Census Bureau
USDA.........................U.S. Department of Agriculture
USDOI .......................U.S. Department of the Interior
USEIA........................U.S. Energy Information Administration
USFS ..........................U.S. Forest Service
USFWS ......................U.S. Fish and Wildlife Service
USGS .........................U.S. Geological Survey
USNVC ......................U.S. National Vegetation Classification System
USR............................Updated Study Report
VSP ....viable salmon population
WAC ....Washington Administrative Code
WDF...........................Washington Department of Fisheries
WDFW.......................Washington Department of Fish and Wildlife
WDMP ....Woody Debris Management Plan
WDW ....Washington Department of Wildlife
WHBR........................Washington Heritage Barn Register
WHCV ....Wetlands of High Conservation Value
WHR ....Washington Heritage Register
WIP ....Wetland Intrinsic Potential
WISAARD.................Washington Information System for Architectural and Archaeological Records Data
WMRC.......................Wildlife Management Review Committee

WNHP........................Washington Natural Heritage Program

WRIA.........................Water Resources Inventory Area

WSA...........................Wildlife Settlement Agreement

WSDOT ....Washington State Department of Transportation

WWTIT......................Western Washington Treaty Indian Tribes

WWU.........................Western Washington University

EXECUTIVE SUMMARY

Seattle City Light (City Light) owns and operates the Skagit River Hydroelectric Project (Skagit River Project or Project) under a license administered by the Federal Energy Regulatory Commission (FERC). The current license expires on April 30, 2025 and City Light intends to apply for a new Project license. The first step in the multi-year relicensing process is to file a Notice of Intent (NOI) to license the Project with the FERC, along with a Pre-Application Document (PAD) no later than April 30, 2020. City Light must file an application for the new license no later than April 30, 2023.

The PAD includes descriptions of the Project facilities, operations, license requirements, and lands as well as a summary of the extensive existing information available on Project area resources. In preparation for the relicensing process, City Light engaged 21 parties, including federal and state agencies, Indian tribes, and non-governmental organizations (NGO), in a Collaborative Study Plan Development Process to identify issues and information gaps to inform development of the PAD. This process identified three studies for early implementation and informed the 24 proposed studies included in this PAD.

The Project

The Project is in Whatcom, Skagit, and Snohomish counties, Washington and consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities. The Project generating facilities are in the Cascade Mountains of the upper Skagit River watershed, between river miles (RM) 94 and 127. Power from the Project is transmitted via two 230-kilovolt powerlines that span over 100 miles and end just north of Seattle at the Bothell Substation. The Project also includes two City Light-owned towns, the Environmental Learning Center (ELC), several recreation sites, and approximately 10,850 acres of fish and wildlife mitigation lands.

The Project was developed over a 42-year period, beginning with construction of Gorge Powerhouse and a timber-crib dam in 1919, and finishing with the completion of the existing concrete-arch dam at the Gorge Development in 1961. The final phase of the Project, construction of High Ross Dam, was suspended in 1984 with the signing of the High Ross Treaty between the United States and Canada. Based on information collected during studies conducted for the current license, the three Project dams are located above two natural barriers to anadromous fish passage.

The Project generating facilities are entirely within the Ross Lake National Recreation Area (RLNRA), which is administered by the National Park Service (NPS) as part of the North Cascades National Park Complex. RLNRA was established in 1968 in the enabling legislation for North Cascades National Park to provide for the "public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge lakes." FERC, formerly the Federal Power Commission (FPC), maintains jurisdiction over the Project (Public Law 90-544. Sec. 505 dated October 2, 1968, as amended by Public Law 100-668. Sec. 202 dated November 16, 1988). Approximately one mile of Ross Lake, the upper-most Project reservoir, is in British Columbia and is part of the Skagit Valley Provincial Park. The roughly 60-mile stretch of the Skagit River several miles downstream of the Project is designated as a wild and scenic river and is managed by the U.S. Forest Service (USFS).

The three Skagit generating developments are hydraulically coordinated to act as a single project and supply approximately 20 percent of City Light's power requirements. The operational priorities for the Project are, in descending order of importance: flood control, downstream fish protection, recreation, and power production. The Project also plays an important role in the regional energy market by integrating renewable resources and providing generation reserves. Total authorized installed capacity of the Project is 650.25 megawatts (MW); a revised Exhibit M updating the installed capacity to 805 MW is pending FERC's approval.[1]

Regionally, the Skagit River is a critically important resource. It is one of the largest rivers in Washington State and the only Puget Sound river that supports all five native salmonid species. It provides spawning, incubation, and rearing habitat for three federally threatened listed fish species—Chinook Salmon, steelhead, and Bull Trout—and is well known for the large numbers of bald eagles that winter along the river and in its floodplain. The floodplain along the lower Skagit River contains rich agricultural land and supports thousands of migrating waterfowl and raptors. Puget Sound Partnership describes the Skagit River watershed as "a fertile center of productivity for high-profile members of the ecosystem's food web including salmon, whales, herring, eagles, and people."

The Current Project License

The first license for the Project was issued by the FPC, FERC's predecessor agency, in 1927 and extended to 1977. The first relicensing process took nearly 18 years, from 1977 until 1995, and was conducted using the Traditional Licensing Process, which was the only approach available at the time. However, to develop a more comprehensive license City Light also engaged in a parallel, collaborative process with 12 agencies, tribes, and other NGOs. The intent was to negotiate a settlement agreement to mitigate Project impacts and benefit the Skagit River ecosystem. Signed in 1991, it was the first comprehensive settlement agreement in the country to be developed for a major hydroelectric project. The agreements were recognized as a national model and were described as "the most comprehensive set of settlement agreements for the public good ever submitted to FERC" (Dean Shumway, Director, FERC Office of Hydropower Licensing, December 18, 1992).

The current license, the second one for the Project, was issued in 1995 for 30 years. It consists of 21 articles related to generation operations, as well as measures for mitigating effects on natural and cultural resources. The license was modified by FERC in a 1996 Rehearing Order to include, at City Light and other signatories' request, all the settlement agreement measures. An amendment issued in 2013 authorized construction of a second power tunnel at the Gorge Development; incorporated several changes in Project flows to better protect downstream fish habitat; and added conservation measures for three fish species federally listed as threatened after 1995.

[1] The current authorized installed capacity of the Project is 650.25 MW (FERC 1997). In March 2020, City Light filed an updated Exhibit M, which upon approval by FERC, will increase the authorized installed capacity to approximately 805 MW.

Implementation of the current license resulted in some significant changes in Project operations, particularly at the Gorge Development. The flow-management plan developed as part of the fisheries settlement agreement and incorporated into the license requires that City Light strive for 100 percent protection of salmon and steelhead. The flow management plan is unique—it puts the needs of fish first, ahead of power production. Under this policy, flows are adjusted on a seasonal, monthly, and daily basis to supply water for spawning, incubation, and protection of juvenile salmon and steelhead. Summer/Fall Chinook, in particular, have responded well; in comparison to the lower river, the proportion of Chinook spawning in the upper Skagit River climbed from 60 to 80 percent over the past 25 years (WDFW 2019).

Other notable outcomes of the current Project license include the protection of nearly 11,000 acres of fish and wildlife habitat in the Skagit, Sauk, and South Fork Nooksack watersheds; improvements to recreational facilities along Ross Lake, the Skagit and Sauk rivers, and the State Route (SR) 20 Scenic Byway; stabilization of multiple erosion sites along Project reservoirs and roads; construction and operation of the ELC, which provides environmental education to over 6,000 students and adults annually; protection of archaeological sites and historic structures in the Project Boundary; and continuation of the legacy of Skagit Tours. Successes under the current license are the result of close collaboration and coordination between and among City Light and the signatories to the Settlement Agreements.

Relicensing Goals and Objectives

City Light's mission is to deliver affordable, reliable, and environmentally responsible electricity services. Its values include safety, environmental stewardship, innovation, excellence and customer care. City Light also has a long history of working collaboratively with agencies, tribes, and NGOs in the implementation of the current Project license. City Light's mission and values, along with its regard for the priorities of its partners in the Skagit River basin, were used to guide the development of the goal and objectives for relicensing the Project.

City Light's goal for the relicensing process is to secure a new federal operating license that allows the Project to continue to balance non-power benefits with its critical regional role producing clean, carbon-free energy and integrating renewable solar and wind resources in an energy market that is rapidly evolving to adapt to new environmental and climate realities.

To meet this goal, City Light will need to accomplish the following objectives:

- Identify operational measures that optimize power generation and non-power benefits including flood control, downstream fish habitat protection, and Project-related recreation.
- Define a range of operational scenarios that optimize flexibility of Project generation needed to adapt to changing climate and energy market conditions.
- Develop a suite of license measures based on the best available information and science that protect resources, mitigate for Project effects, and enhance resources affected by the Project.
- Identify any modifications that could improve Project economics to maintain affordability of electricity for City Light customers.

Relicensing Process

City Light has been working closely with all the parties to the settlement agreements in the current license for 25 years. In January 2019, City Light began implementing a Collaborative Study Plan Development Process in preparation for initiating the formal relicensing process. Participants in this process included representatives from the signatories to the 1991 settlement agreement and new parties interested in the Project. The purpose of this early process was to provide a forum, a structure, and the time to collaborate with interested parties towards the goal of identifying resource issues that may warrant study during relicensing. The objectives were to: (1) develop a suite of agreed-upon issues and associated studies for inclusion in this PAD; (2) identify studies that could potentially be implemented early to allow more time to gather relevant information; and (3) identify additional sources of relevant information.

City Light's strong commitment to environmental protection will help to guide the relicensing process and resulting implementation strategies for protection, mitigation, and enhancement (PME) measures in the new license for the Project. City Light will use the Integrated Licensing Process (ILP) as the framework for obtaining the information necessary for FERC to relicense the Project. The ILP is FERC's default process for relicensing large hydroelectric projects and it provides a set of deliverables and timeframes for obtaining, synthesizing, and submitting information. In addition to the formal ILP, City Light intends to create opportunities for close collaboration with licensing participants (LP), including tribes, state and federal agencies, and NGOs. The structure for this collaboration was established in 2019 and includes Resource Work Groups (RWG) to develop study plans, review study results, and develop proposed management plans and other resource protection measures to be implemented in the new license. The PAD is intended to provide the background information necessary to initiate these discussions.

Next Steps

Filing the NOI and PAD formally begins the second relicensing process in the history of the Skagit River Project. The full schedule for the ILP can be found in Section 2 of this PAD. Section 3 provides a detailed description of Project facilities, lands, and operations. It also includes a summary of anticipated maintenance obligations, large, capital rehabilitation or upgrade projects, and possible new facilities or modifications to existing Project facilities. Section 4 is a comprehensive summary of the natural and cultural resources in the Project vicinity based on research, monitoring, literature, and observations over the last 50 years, and in some cases longer.

Informed by the extensive amount of research conducted prior to and during the current license, LPs and City Light have identified preliminary issues for study during relicensing. This preliminary issue identification informed City Light's 24 proposed studies as outlined in PAD Section 5; draft study plans for the three studies that will be initiated in 2020 are appended to this PAD.

In 2020, City Light will initiate formal public consultation in accordance with the requirements of the ILP process and develop the remaining study plans in collaboration with LPs. City Light will submit the Proposed Study Plan (PSP) document to FERC, conduct the meetings required under the ILP, and continue meetings with RWGs. It is hoped that the long-standing and productive relationships established and cemented during the current license will be sustained and strengthened during relicensing and settlement agreement negotiations to the benefit of the Skagit River basin’s natural and cultural resources for the duration of a future 50-year license term.

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1.0 INTRODUCTION

1.1 Purpose and Structure of Pre-Application Document

The Skagit River Hydroelectric Project (Skagit River Project or Project), owned and operated by Seattle City Light (City Light), was constructed between 1919 and 1961 and operates under a license administered by the Federal Energy Regulatory Commission (FERC). The Project is on the Skagit River and spans Whatcom, Skagit, and Snohomish counties in Washington State.

The current license for the Project (FERC No. 553), issued on May 16, 1995, will expire on April 30, 2025, and in accordance with FERC regulations, City Light must file its application for a new license no later than April 30, 2023. City Light's filing of this Pre-Application Document (PAD) and accompanying Notice of Intent (NOI) to seek a new license for the Project initiates the formal relicensing process. City Light is utilizing FERC's Integrated Licensing Process (ILP) for relicensing of the Project.

The PAD and NOI, as filed with FERC, will be available to all known interested state and federal agencies, tribes, local governments, non-governmental organizations (NGO), and members of the public. The purpose of the PAD is to provide FERC, participants in the relicensing process (licensing participants [LP]), and members of the public with summaries of existing, relevant, and reasonably available information. The PAD also provides information to be used in the environmental analysis section of the license application and in FERC's scoping documents and environmental assessment under the National Environmental Policy Act (NEPA).

The effort to systematically identify and obtain all existing, relevant, and reasonably available information related to the Project and effected resources as source material for this PAD, was extensive. Much of the information was developed by City Light from the results of research and monitoring conducted over the course of the current Project license. Additional information relevant to relicensing was provided by LPs during a series of Resource Work Group (RWG) meetings held in 2019 as part of the Collaborative Study Plan Development Process. The primary goal of this voluntary and early consultation process was to identify resource issues that may warrant study during relicensing. Section 5 of this PAD provides greater detail on this early and informal process and describes City Light's proposed studies and management plans which are intended to substantially address the over 90 resource issues discussed during the informal process. Three draft study plans recommended during this process for early implementation are appended to this PAD.

Beginning in 2017, City Light initiated an effort to digitize and catalogue its library of internally held information on the Skagit River, as well as data and reports provided by LPs. City Light's extensive library includes publicly available documents such as original surveys, engineering reports, license related documents, scientific research, and third party (consultant, tribe, and agency) documentation of implementation of mitigation programs. Documents used to support the PAD are stored in the Skagit Relicensing Public Document Library on City Light's website (http://www.seattle.gov/light/skagit/Relicensing/default.htm)[2] and are identified in the reference list (Section 8.0 of this PAD).

This PAD, and the materials referenced herein, will be made available at the City Light offices during normal business hours pursuant to the requirements of 18 Code of Federal Regulations (CFR) § 5.2, upon request. This PAD follows the form and content requirements of 18 CFR § 5.6(c), (d), and (e) and is organized in sections as described below. Table 1.1-1 provides a detailed cross reference to the required information in these regulations.

- **Section 1.0** – Introduction and contents of the PAD.
- **Section 2.0** – Process plan and schedule for all pre-application activity, including the proposed location and date for the scoping meetings and site visit, per 18 CFR § 5.6(d)(1).
- **Section 3.0** – Description of the Project location, facilities, and current and proposed operation of the Project, per 18 CFR § 5.6(d)(2).
- **Section 4.0** – Description for the Skagit River basin and of the existing environment and Project impacts, by resource area, per 18 CFR § 5.6(d)(3).
- **Section 5.0** – Preliminary resource issues and potential studies or information-gathering needs associated with the issues, per 18 CFR § 5.6(d)(4)(i)-(ii).
- **Section 6.0** – Summary of relevant qualifying federal and state or tribal comprehensive plans, and resource management plans, per 18 CFR § 5.6(d)(4)(iii)-(iv).
- **Section 7.0** – Summary of contacts with federal, state, and interstate resource agencies, Indian tribes, NGOs, and other interested parties made in connection with development of this PAD, per 18 CFR § 5.6(d)(5).
- **Section 8.0** – References used in development of the PAD, per 18 CFR § 5.6(c)(2).

Table 1.1-1. Cross reference of PAD section and CFR PAD requirements.

18 CFR § 5.6(d)	PAD Content Requirement	PAD Section
(1)	Process plan and schedule; scoping meeting and site visit	2.1
(2)	Project location, facilities, and operations	3.0
(2)(i)	Agent for City Light	3.1
(2)(ii)	Maps of the Project and lands and waters within the Project boundary	3.2, 3.4.11, Appendix
(2)(iii)	Existing Project facilities	3.4
(2)(iii)(A)	Description of Project structures – dams, spillways, penstocks, canals, powerhouses, tailraces	3.4.1-3.4.3
(2)(iii)(B)	Reservoir normal maximum surface area and elevation, gross storage capacity	3.4.1 – 3.4.3; Table 3.4-1
(2)(iii)(C)	Proposed generation number and type, minimum/maximum hydraulic and rates capacity	3.4.1 – 3.4.3; Table 3.4-1
(2)(iii)(D)	Transmission line length, voltage, connection to grid	3.4.5
(2)(iii)(E)	Generation dependable capacity, average annual and monthly energy production	3.5.3.1 and 3.5.3.2

[2] Documents containing confidential information are not made publicly available on the website.

18 CFR § 5.6(d)	PAD Content Requirement	PAD Section
(2)(iv)	Description of current and proposed Project operation	3.5 and 3.7
(2)(v)(A)	Current license requirements	3.6.1
(2)(v)(B)	Generation and flow information for past five years	3.5.3.2 and 3.5.3.3
(2)(v)(C)	Current net investment	3.6.4
(2)(v)(D)	Compliance history	3.6.3
(2)(vi)	Description of new features, facilities, or changes in operation	3.7
(3)(i)(A)	Description of existing environment by resource area	4.0
(3)(i)(B)	Summaries of existing data or studies regarding each resource	4.0
(3)(i)(C)	Known or potential adverse impacts or issues, continuing or cumulative	4.0
(3)(i)(D)	Protection, mitigation, and enhancement (PME) measures, required or otherwise implemented	4.0
(3)(ii)	**Geology and soils**	4.3
(3)(ii)(A)	Geology – bedrock lithology, stratigraphy, glacial features, unconsolidated deposits, mineral resources	4.3.1
(3)(ii)(B)	Soils – types, occurrence, physical and chemical characteristics, erodibility, mass soil movement potential	4.3.2
(3)(ii)(C)	Reservoir shoreline and streambank – steepness, composition, vegetative cover, erosion, mass soil movement, slumping, or other forms of instability	4.3.4
(3)(iii)	**Water resources**	4.4
(3)(iii)(A)	Drainage area	4.4.1.1
(3)(iii)(B)	Minimum, mean, and maximum monthly flow at power plant intake or point of diversion	4.4.2.2
(3)(iii)(C)	Monthly flow duration curves	4.4.2.3 (Appendix)
(3)(iii)(D)	Water use, domestic and industrial water supply, water use requirements	4.4.3
(3)(iii)(E)	Water rights, certificated and applications	4.4.3
(3)(iii)(F)	Federal water quality standards applicable to Project waters	4.4.5.1
(3)(iii)(G)	Water quality season variation in stream or reservoirs of Project	4.4.5.2
(3)(iii)(G)(1)	Temperature, dissolved oxygen	4.4.5.2
(3)(iii)(G)(2)	Total dissolved gas, pH, total hardness, specific conductance, chlorophyll *a*, suspended sediment concentrations, total nitrogen, total phosphorus, fecal, and coliform concentrations	4.4.5.2
(3)(iii)(H)	Reservoir surface area, volume, maximum depth, mean depth, flushing rate, shoreline length, substrate composition	3.4.1 – 3.4.3; Table 3.4-1; 4.4.1.2
(3)(iii)(I)	Gradient of downstream reaches affected by the Project	4.4.1.3
(3)(iv)	**Fish and aquatic resources**	4.5
(3)(iv)(A)	Fish and aquatics communities	4.5.1 and 4.5.2
(3)(iv)(B)	Essential fish habitat	4.5.4.2
(3)(iv)(C)	Temporal and spatial distribution – species and life stage composition, standing crop, age and growth data, spawning run timing, and extent and location of spawning, rearing, feeding, and wintering habitat	4.5.1 and 4.5.2

18 CFR § 5.6(d)	PAD Content Requirement	PAD Section
(3)(v)	**Wildlife and botanical resources**	4.6 and 4.7
(3)(v)(A)	Upland habitats in vicinity and transmission corridor for species, including plants and animals	4.6.1.1 – 4.6.1.3, 4.7.1
(3)(v)(B)	Temporal and spatial distribution of species with commercial, recreational, and cultural value	4.6.2, 4.7.5
(3)(vi)	Wetlands, riparian, and littoral habitat	4.6.1.1 – 4.6.1.3
(3)(vi)(A)	List of plant and animal species including invasive species that use the wetlands, riparian, and littoral habitats	4.6.1.1 – 4.6.1.3, 4.6.3, 4.7.1
(3)(vi)(B)	Map delineating wetlands, riparian, and littoral habitats	4.6.1.1 – 4.6.1.3
(3)(vi)(C)	Acreage estimates for wetlands, riparian, and littoral habitats, including availability as a function of storage	4.6.1.1 – 4.6.1.3
(3)(vii)	**Rare, threatened, and endangered species**	4.5, 4.6, and 4.7
(3)(vii)(A)	Federal- and state-listed or proposed to be listed species	4.5.3, 4.6.6.1 – 4.6.6.3, and 4.7.2.1
(3)(vii)(B)	Habitat requirements	4.5.3, 4.6.6.1 – 4.6.6.3, and 4.7.2.1
(3)(vii)(C)	Reference to any biological opinion, status report, or recovery plan pertaining to listed species	4.5.3, 4.6.6.1 – 4.6.6.3, and 4.7.2.1
(3)(vii)(D)	Federally designated critical habitat or other habitat in Project area	4.5.4, 4.6.6.4, and 4.7.2.2
(3)(vii)(E)	Temporal and spatial distribution of listed species in Project vicinity	4.5.3, 4.6.6.1 – 4.6.6.3, and 4.7.2.1
(3)(viii)	**Recreation and land use**	4.8
(3)(viii)(A)	Existing recreational facilities, activity type supported, location, capacity, ownership, and management	4.8.1
(3)(viii)(B)	Current recreational use of project lands and waters compared to facility or resource capacity	4.8.2
(3)(viii)(C)	Shoreline buffer zones within Project boundary	4.8.3
(3)(viii)(D)	Current and future recreation needs identified in State Comprehensive Outdoor Recreation Planning (SCORP), other applicable plans on file with FERC, or other relevant local, state, or regional conservation and recreation plans	4.8.4
(3)(viii)(E)	Licensee's current shoreline management plan or policy	4.8.5
(3)(viii)(F)(i) and (ii)	Project lands within or adjacent to National Wild and Scenic River System or state-protected waters	4.8.6
(3)(viii)(G)	Project lands within or adjacent to National Trails System or Wilderness area	4.8.7
(3)(viii)(H)	Regionally or nationally important recreation areas in the Project vicinity	4.8.8
(3)(viii)(I)	Non-recreational land use and management within the Project boundary	4.8.9.1
(3)(viii)(J)	Recreational and non-recreational land use and management adjacent to the Project boundary	4.8.9.2
(3)(ix)	**Aesthetic resources** Visual characteristics of lands and waters affected by the Project (dam, natural water features, other scenic attractions of Project and surrounding vicinity)	4.9.1

18 CFR § 5.6(d)	PAD Content Requirement	PAD Section
(3)(x)	**Cultural resources**	4.10
(3)(x)(A)	Historic and archaeological sites in Project vicinity especially listed by State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Officer (THPO) for inclusion in the National Historic Register of Historic Places	4.10.4
(3)(x)(B)	Existing discovery measures for locating, identifying, and assessing significant historic or archaeological resources within or adjacent to Project boundary	4.10.4
(3)(x)(C)	Indian tribes that attach religious or cultural significance to historic properties within the Project boundary or in the Project vicinity and available information on Indian traditional cultural and religious properties	4.10.5
(3)(xi)	**Socio-economic resources** Socio-economic conditions in the Project vicinity, including land use patterns, population patterns, and sources of employment in the Project vicinity	4.12.1 – 4.12.5
(3)(xii)	**Tribal resources**	4.11
(3)(xii)(A)	Project-induced impacts on tribal, cultural, or economic interests	4.11.1 – 4.11.5
(3)(xii)(B)	Project impacts on tribal agreements with other entities	4.11.1 – 4.11.5
(3)(xiii)	River basin description	4.2
(3)(xiii)(A)	Area of basin and length of stream reaches	4.2.1
(3)(xiii)(B)	Major land and water uses in Project area	4.2.2
(3)(xiii)(C)	Dams and diversion structures in basin	4.2.4
(3)(xiii)(D)	Tributary rivers and streams that may be affected by Project operations	4.2.3
(4)(i)	Preliminary issues by resource area	5.0
(4)(ii)	Potential studies and information needs	5.0
(4)(iii)	Relevant qualifying federal and state or tribal comprehensive plans	6.0
(4)(iv)	Relevant resource management plans	6.0
(5)	Summary of contacts	7.0
5.6(c)(2)	References of source information on the existing environment and known or potential resource impacts included in the descriptions and summaries	8.0
5.6(e)	Statement of whether or not applicant will seek benefits under section 210 of Public Utility Regulatory Policies Act of 1978 (PURPA)	3.6.5

1.2 Relicensing Goals and Objectives

City Light's mission is to deliver affordable, reliable and environmentally responsible electricity services. Its values include safety, environmental stewardship, innovation, excellence, and customer care. City Light also has a long history of working collaboratively with agencies, tribes, and NGOs in the implementation of the current Project license. City Light's mission and values, along with its regard for the priorities of its partners in the Skagit River basin, were used to guide the development of the goal and objectives for relicensing the Project.

City Light's goal for the relicensing process is to secure a new federal operating license that allows the Project to continue to balance non-power benefits with its critical regional role producing clean, carbon-free energy and integrating renewable solar and wind resources in an energy market that is rapidly evolving to adapt to new environmental and climate realities.

To meet this goal City Light will need to accomplish the following objectives:

- Identify operational measures that optimize power generation and non-power benefits including flood control, downstream fish habitat protection, and Project-related recreation.
- Define a range of operational scenarios that optimize flexibility of Project generation needed to adapt to changing climate and energy market conditions.
- Develop a suite of license measures based on the best available information and science that protect resources, mitigate for Project effects, and enhance resources affected by the Project.
- Identify any modifications that could improve Project economics to maintain affordability of electricity for City of Seattle customers.

2.0 PROCESS PLAN, SCHEDULE, AND CONSULTATION

2.1 Process Plan and Schedule

The relicensing process plan and schedule outlines the steps and timing associated with the ILP for the Skagit River Project. The schedule presented in Table 2.1-1 identifies each of the key steps in the relicensing from PAD and NOI submittal through filing of a Final License Application (FLA) in 2023. Key relicensing milestones, around which the schedule was developed, include:

- NOI Due Date (5 to 5.5 years prior to licensing expiration) 11/1/2019 – 4/30/2020
- Filing deadline for FLA 4/30/2023
- License Expiration Date 4/30/2025

Pursuant to 18 CFR § 5.7 and the Tribal Policy Statement (18 CFR § 2.1c) as recently revised in October 2019 in FERC Order No. 863, within 30 days of filing the NOI and PAD FERC will conduct its initial tribal consultation meeting(s) with tribes interested in attending. FERC also will issue a notice of commencement of the relicensing proceeding along with Scoping Document 1 (SD1) within 60 days of the receipt of this PAD. Public scoping meetings are tentatively scheduled to take place the week of July 27, 2020 near the Project. This scoping process will inform FERC's analysis of the Project's potential environmental impacts under NEPA. The Project site visit will be available to the public and will be held in conjunction with the scoping meetings.

The relicensing process plan and schedule (Table 2.1-1) reflects the mandatory timeframes and deadlines specified in FERC's regulations, including consultation with interested agencies and tribes, through filing of the FLA. The Process Plan and Schedule may be modified throughout the process with the approval of FERC. FERC will establish a schedule for application processing after the license application is filed. Other related regulatory processes including Washington Department of Ecology's (Ecology) Section 401 water quality certification process, the U.S. Fish and Wildlife Service's (USFWS) and National Marine Fisheries Service's (NMFS) Section 7 Endangered Species Act (ESA) consultation, and consultation pursuant to Section 106 of the National Historic Preservation Act (NHPA) will continue following filing of the FLA. With the filing of this PAD, City Light has requested that FERC designate City Light as FERC's non-federal representative for purposes of initiating and conducting day-to-day consultation under ESA Section 7 and NHPA Section 106.

Table 2.1-1. ILP milestones for the Skagit River Project through filing of the FLA.

Significant Pre-filing Milestones	Responsible Party	Timeframe	Date [1]	FERC Regulation
Filing of NOI and PAD	City Light	As early as 5.5 years, but no later than 5 years prior to license expiration	4/30/2020	18 CFR § 5.5 and §5.6
Initial Tribal Consultation Meeting(s)	FERC	No later than 30 days after filing NOI and PAD	5/30/2020	18 CFR § 5.7
Notice of NOI/PAD and Issuance of Scoping Document 1 (SD1)	FERC	Within 60 days of filing NOI and PAD	6/29/2020	18 CFR § 5.8

Significant Pre-filing Milestones	Responsible Party	Timeframe	Date [1]	FERC Regulation
Scoping Meeting/Site Visit	FERC	Within 30 days of NOI/PAD notice and issuance of SD1	Week of 7/27/2020	18 CFR § 5.8(b)
Comments on PAD, SD1, and Study Requests	FERC, LPs	Within 60 days of NOI/PAD notice and issuance of SD1	8/28/2020	18 CFR § 5.9(a)
Issuance of Scoping Document 2 (SD2), if necessary	FERC	Within 45 days of deadline for filing comments on SD1	10/12/2020	18 CFR § 5.10
File Proposed Study Plan (PSP)	City Light	Within 45 days of deadline for filing comments on PAD	10/12/2020	18 CFR § 5.11
Study Plan Meeting(s)	City Light	Initial meeting to be held within 30 days of filing PSP	11/11/2020	18 CFR § 5.11(e)
Comments on PSP	FERC, LPs	Within 90 days after PSP is filed	1/10/2021	18 CFR § 5.12
File Revised Study Plan (RSP)	City Light	Within 30 days of deadline for comments on PSP	2/9/2021	18 CFR § 5.13(a)
Comments on RSP	LPs	Within 15 days following RSP	2/24/2021	18 CFR § 5.13(b)
Issuance of Study Plan Determination	FERC	Within 30 days of RSP	3/11/2021	18 CFR § 5.13(c)
Formal Study Dispute Resolution Process if requested [2]	Agencies with mandatory conditioning authority	Within 50 days of Study Plan Determination [3]	4/30/2021	18 CFR § 5.14(a)
Dispute Resolution Panel convenes	Dispute Resolution Panel	Within 20 days of notice of study dispute	5/20/2021	18 CFR § 5.14(d)
Comments on Study Plan disputes	City Light	Within 25 days of notice of study dispute	5/25/2021	18 CFR § 5.14(i)
Third panel member selection due	Dispute Resolution Panel	Within 15 days of when Dispute Resolution Panel convenes	6/4/2021	18 CFR § 5.14(d)(3)
Dispute Resolution Panel technical conference	Dispute Resolution Panel, City Light, LPs	Prior to engaging in deliberative meetings	TBD	18 CFR § 5.14(j)
Dispute Resolution Panel findings and recommendations	Dispute Resolution Panel	No later than 50 days after notice of dispute	6/19/2021	18 CFR § 5.14(k)
Study Dispute Determination	FERC	No later than 70 days after notice of dispute	7/9/2021	18 CFR § 5.14(1)
Conduct First Season of Studies	City Light		2021	18 CFR § 5.15
Initial Study Report (ISR)	City Light	Pursuant to the Commission-approved study plan and schedule provided in §5.13 or no later than 1 year after Commission approval of the study plan	3/11/2022	18 CFR § 5.15(c)

Significant Pre-filing Milestones	Responsible Party	Timeframe	Date [1]	FERC Regulation
ISR meeting	City Light and LPs	Within 15 days of filing the Initial Study Report	3/26/2022	18 CFR § 5.15(c)(2)
File ISR Meeting Summary	City Light	Within 15 days of study results meeting	4/10/2022	18 CFR § 5.15(c)(3)
File Meeting Summary disagreements [2]	LPs	Within 30 days of study results Meeting Summary	5/10/2022	18 CFR § 5.15(c)(4)
File responses to Meeting Summary disagreements	City Light	Within 30 days of filing Meeting Summary disagreements	6/9/2022	18 CFR § 5.15(c)(5)
Study Dispute Determination	FERC	Within 30 days of filing responses to disagreements	7/9/2022	18 CFR § 5.15(c)(6)
Conduct Second Season of Studies	City Light		2022	18 CFR § 5.15
File Preliminary Licensing Proposal (PLP) or Draft License Application (DLA)	City Light	No later than 150 days prior to the deadline for filing a new or subsequent license application	12/1/2022	18 CFR § 5.16
File Updated Study Report (USR)	City Light	Pursuant to the Commission-approved study plan and schedule provided in §5.13 or no later than 2 years after Commission approval	3/11/2023	18 CFR § 5.15(f)
USR meeting	City Light and LPs	Within 15 days of USR	3/26/2023	18 CFR § 5.15(f)
File USR Meeting Summary	City Light	Within 15 days of USR meeting	4/10/2023	18 CFR § 5.15(f)
Comments on PLP or DLA	LPs	Within 90 days of filing DLA	3/1/2023	18 CFR § 5.16(e)
File Meeting Summary Disagreements [2]	LPs	Within 30 days of study results meeting summary	5/10/2023	18 CFR § 5.15(f)
File Responses to Meeting Summary Disagreements	City Light	Within 30 days of filing meeting summary disagreements	6/9/2023	18 CFR § 5.15(f)(5)
Study Dispute Determination	FERC	Within 30 days of filing responses to disagreements	7/9/2023	18 CFR § 5.15(f)
File FLA	City Light	No later than 24 months before the existing license expires	4/30/2023	18 CFR § 5.17(a)

1 If the due date falls on a weekend or holiday, the deadline is the following business day.
2 Shaded actions are not necessary if there are no study or meeting summary disputes.
3 18 CFR § 5.14(a) requires agencies with mandatory conditioning agency authority to request Formal Dispute resolution within 20-days of the Study Plan Determination. The schedule in this table reflects a 30-day extension requested by City Light with the filing of this PAD.

2.2 Participation in the Skagit Relicensing Process

City Light will be responsible for coordinating ILP-related relicensing activities among LPs during the pre-filing period. In order to inform this PAD and the study plan development process, in 2019 City Light implemented the Collaborative Study Plan Development Process. City Light intends to use a tiered working group structure similar to the one created in 2019. The proposed structure is comprised of a policy-level Steering Committee and RWGs centered around the following major resource areas: (1) cultural resources; (2) fish and aquatics; (3) recreation and aesthetics; and (4) terrestrial resources and reservoir erosion.

Participation in the Skagit River Project relicensing process is open to any governmental agency, NGO, tribe, or member of the public. Participation in the RWGs or Steering Committee is voluntary. Any interested LP may elect to participate by self-identifying its participation in the Steering Committee and/or any of the RWGs. LPs may request to be added to RWG and/or Steering Committee contact list by sending an email to Skagit.River@hdrinc.com that provides their name, organization, and the RWG they wish to participate in. Each participating LP is expected to identify primary and alternate representatives for the Steering Committee and the RWGs in which they intend to be involved to allow for efficient decision-making. City Light will have one or more representatives on the Steering Committee and each of the RWGs.

By participating in the RWGs and/or Steering Committee, no federal or state resource agency will waive their statutory rights and authorities in the relicensing process for the Skagit River Project, nor will any federal or state resource agency be deemed to have predetermined the outcome of the exercise of their statutory rights and authorities. By participating in this process, no party waives its right to take any timely action pursuant to FERC's ILP regulations.

2.3 Communications and Distribution Plans

This section summarizes generally how City Light plans to communicate with LPs throughout the relicensing and how documents will be distributed. In cooperation with LPs, these communication guidelines may be revised as necessary during the relicensing process. These guidelines do not apply to FERC or any documents, meetings, correspondence, or other actions for which FERC is responsible during the relicensing proceeding.

2.3.1 Modes of Communication

The preferred method for process communications (e.g., meeting notices, coordination, logistics, etc.) will be electronic. The primary mode of document distribution will be through the Project relicensing website, accessible online at http://www.seattle.gov/light/skagit/. Documents used to support the PAD are stored in the Skagit Relicensing Public Document Library on City Light's website at http://www.seattle.gov/light/skagit/Relicensing/default.htm. Documents filed with the Commission will be available from FERC's elibrary at www.ferc.gov/docs-filing/elibrary.asp by searching under Docket P-553. City Light will also post all FERC required filings, including meeting materials (e.g., agendas, handouts, and summaries), study plans and reports, and other relicensing documents, such as the PAD and PSP, on the Skagit Relicensing Public Document Library to increase the availability of these materials to all interested parties.

City Light will use email notifications to LPs to announce important new postings, which will help maximize review and comment opportunities, where applicable. Informal communications, such as those among City Light representatives and RWG LPs, will be conducted primarily by email.

To facilitate collaboration in the Steering Committee and RWGs, City Light will maintain a web-based platform (e.g., SharePoint site) for document sharing and for the dissemination of draft study plans and other licensing documents requiring review. The site will also serve as a repository for existing information and meeting materials (e.g., agendas, meeting summaries, meeting materials, etc.).

2.3.2 Steering Committee and RWG Meeting Notices and Agendas

City Light will strive to provide at least 30 days prior notice for any meetings among the RWGs and Steering Committee. During the study plan development phase of the relicensing (i.e., through the third quarter of 2020), City Light will work with the RWGs and Steering Committee to establish regularly scheduled meetings for the purpose of facilitating development of a comprehensive relicensing study plan.

To the extent possible, agenda topics for subsequent meetings will be identified at the end of each meeting. City Light will target distribution of an agenda and any relevant materials at least 10 days in advance of all Steering Committee and RWG meetings. It is expected that all LPs will strive to meet this 10-day advance distribution target if they have relevant information they intend to share during a meeting. If any LP suggests modification to the agenda, the primary or alternate representative of an organization will provide comments to the group within five days of receiving the agenda. City Light will confirm a final agenda at least three days prior to a meeting.

Agendas will include:

- Date, start and end time, and location;
- Meeting objectives;
- Topics for discussion and amount of time;
- Topics for decision making at the meeting will be noted as such; and
- Status of action items from the previous meeting.

For any additional engagements necessary between regularly scheduled meetings, meeting agendas and meeting materials will be provided as soon as possible.

2.3.3 RWG and Steering Committee Meeting Locations

With input from RWG and Steering Committee members, City Light will be responsible for identifying a location for respective RWG and Steering Committee meetings. It is anticipated that in-person meetings will take place in Mt. Vernon, Burlington, Everett, or Sedro-Woolley, Washington. For each meeting, City Light will provide call-in opportunities and Skype meeting presentations to allow for remote participation.

2.3.4 RWG and Steering Committee Meeting Summaries

For each RWG and Steering Committee meeting, City Light will prepare a meeting summary. Meeting summaries are intended to capture the highlights of each meeting and to help LPs stay informed of the work being completed by the RWGs and Steering Committee. As such, each meeting summary will consist of the following elements, as appropriate:

- Identification of all meeting participants;
- List of issues discussed;
- Specification of any decision reached;
- List of all action items, including due date and responsible entity; and
- Identification of potential agenda items for the next meeting, together with the date of next meeting.

City Light will distribute a draft meeting summary within 12 days of each RWG and Steering Committee meeting. Each entity which attended the meeting may provide comments on the draft meeting summary. Comments will be due within 10 days of receipt of the draft meeting summary. A final meeting summary will be prepared by City Light and shared with LPs within 30 days of the meeting date.

2.3.5 Consultation Record

Except for certain protected information (e.g., sensitive cultural resources information and critical energy/electric infrastructure information), all materials shared among the parties participating in the relicensing process are potentially subject to broad public disclosure and are not considered confidential. In addition, documents produced during RWG and Steering Committee meetings will be submitted to FERC as part of the relicensing consultation record. City Light will maintain electronic and/or hard copies of all relevant written communications, meeting summaries, reports, and project documents in a consultation record. CEII and Privileged documents in the consultation record may have restricted access.

To place a document in FERC's official project file you may electronically file documents with FERC, see instructions at https://www.ferc.gov/docs-filing/efiling-user-guide.pdf.

2.4 Development of a Relicensing Study Program

Several sequential steps are involved in the development of a final study plan for a program of studies to support City Light's license application. These steps, as described briefly below, include the preliminary identification of issues and study needs, consideration of formal study requests from LPs in response to the PAD and SD1, development of the PSP, and FERC's final Study Plan Determination.

2.4.1 Identification of Issues

This PAD summarizes existing and relevant information on the Project and forms the basis for City Light's current understanding of the resources potentially impacted by the Project. During the Collaborative Study Plan Development Process, implemented by City Light in 2019 (discussed in more detail in Section 5 of this PAD), over 90 issues were considered by the RWGs and Steering

Committee. Ultimately, this process resulted in the identification of 24 proposed studies to support City Light's application for a new license.

Section 5 provides a summary of the issues and the proposed study plans that will be provided for review and comment to LPs between March and July 2020 through the RWGs and Steering Committee. In accordance with FERC's ILP regulations, City Light must file its PSP package with FERC by October 12, 2020.

2.4.2 Formal Study Requests

Written requests for additional studies must be submitted to FERC no later than 60 days after issuance of SD1. City Light strongly encourages LPs to participate in the RWG and Steering Committee process to informally discuss issues and proposed study plans. LPs who wish to submit formal study requests to FERC must fully address FERC's seven study criteria outlined in 18 CFR § 5.9(b).

2.4.3 Proposed Study Plan

As part of the ILP, City Light is responsible for developing the PSP for review and comment. The ILP regulations assume that a PSP will be developed based on comments and study requests received in response to the issuance of the PAD and SD1. However, to foster its understanding of LPs' interests and questions regarding the relicensing of the Project, City Light plans to engage with the RWGs and Steering Committee to ensure that the PSP, when issued, is responsive to collaborative discussions between City Light and LPs.

Following this effort, and in consideration of any formal study requests submitted by LPs, City Light will issue the PSP for comment no later than October 12, 2020. The PSP will identify all studies that City Light proposes to conduct in response to formal study requests received.

2.4.4 Revised Study Plan and FERC Determination

Within 30 days of filing its PSP, City Light will hold a meeting with LPs to clarify elements of the study plans and attempt to resolve any outstanding questions or issues. LPs are provided 90 days to comment on the PSP, with comments being filed directly with FERC. City Light then has 30 days to propose any revisions to the PSP based on the input received by FERC and file the RSP with FERC. FERC has 30 days to issue its Study Plan Determination regarding the adequacy of the RSP.

Mandatory conditioning agencies that remain dissatisfied with FERC's Study Plan Determination may seek resolution through FERC's Director of the Office of Energy Projects, as provided in 18 CFR § 5.14 (see Table 2.1-1).

2.4.5 Initial and Updated Study Reports

As required by 18 CFR § 5.15(c) and (f), City Light will file an ISR and an USR within one and two years, respectively, after FERC's Study Plan Determination. The ISR and USR will describe the progress in implementing the studies and will provide a summary of data collected to date. The ISR and USR are progress reports and may not contain final study results. The ISR and USR will also include a discussion of any variance from the FERC-approved study plan and schedule and any modifications to ongoing studies. As provided in 18 CFR § 5.15(c) and (f), City Light will hold a meeting within 15 days of filing both the ISR and USR and will file a meeting summary within 15 days of both meetings.

3.0 PROJECT LOCATION, FACILITIES, AND OPERATIONS

This section of the PAD contains specific information regarding the Project location, facilities, and operations, as well as City Light's authorized agent. It provides background information on the existing Project, including its history, operating practices, and operational constraints.

3.1 Agent for Application

Andrew Bearlin
Seattle City Light
PO Box 34023
Seattle, WA 98104-4023
206-684-3496
Andrew.Bearlin@seattle.gov

3.2 Project Location

The Skagit River Project is in northern Washington State and consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities (Figure 3.2-1). The Project generating facilities are in the Cascade Mountains of the upper Skagit River watershed, between river miles (RM) 94 and 127. Power from the Project is transmitted via two 230-kilovolt (kV) powerlines that span over 100 miles and end just north of Seattle at the Bothell Substation. The Project also includes two City Light-owned towns, an Environmental Learning Center (ELC), several recreation sites, and several parcels of fish and wildlife habitat mitigation lands.

Project generating facilities are all in Whatcom County, although Ross Lake, the most upstream reservoir, crosses the U.S.-Canada border and extends for about one mile into British Columbia at normal maximum water surface elevation.[3] Gorge Powerhouse, the most downstream facility, is approximately 120 miles northeast of Seattle and 60 miles east of Sedro-Woolley, the nearest large town. The closest town is Newhalem, which is part of the Project and just downstream of Gorge Powerhouse. The primary transmission lines are in Whatcom, Skagit, and Snohomish counties.

The boundary of the Skagit River Project (Project Boundary) is extensive, spanning over 133 miles and 31,451 acres[4] from the U.S.-Canadian border to the Bothell Substation just north of Seattle, Washington (Figure 3.2-1). In addition, there are "islands" of fish and wildlife habitat lands and recreation sites within the Skagit, Sauk, and South Fork Nooksack watersheds that are also within the Project Boundary. Project generating facilities are entirely within the Ross Lake National Recreation Area (RLNRA), which is managed by the National Park Service (NPS) as part of the North Cascades National Park Complex. RLNRA was established in 1968 in the enabling legislation for North Cascades National Park to provide for the "public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge lakes." The legislation also

[3] All elevations cited in this PAD are City of Seattle Datum unless otherwise noted. City Light is in the process of transitioning over to use of North American Vertical Datum of 1988 (NAVD 88) for representation of vertical datum, which will be completed no later than filing of the license application. A table converting elevation values of key Project features from City of Seattle Datum to NAVD 88 and map of the features is appended to the PAD.
[4] Based on Exhibit Ks on file with FERC (dated June 2011, as approved per FERC order [July 2013]).

mandated continued FERC (formerly the Federal Power Commission [FPC]) jurisdiction over the Skagit River Hydroelectric Project, FERC No. 553 and the Newhalem Creek Hydroelectric Project, FERC No. 2705 within RLNRA and existing hydrologic monitoring stations necessary for the proper operation of the hydroelectric projects (Public Law 90-544. Sec. 505 dated October 2, 1968, as amended by Public Law 100-668. Sec. 202 dated November 16, 1988).

The lands adjacent to RLNRA are within North Cascades National Park, much of which is also part of the Stephen Mather Wilderness Area. According to License Article 201 (as revised in 2013; FERC 2013), the Project Boundary, exclusive of the transmission line corridor, includes 19,060.06 acres of federal lands. The Project transmission lines cross a mixture of public lands managed mostly by NPS and Washington State Department of Natural Resources (DNR) and private lands owned by City Light, individuals, corporations, and timber companies. Based on License Article 201 (as revised in 2013; FERC 2013), the transmission line right-of-way (ROW) occupies 221.87 acres of federal land. Land uses adjacent to the transmission line include recreation, habitat conservation, forestry, rural residential, and small-scale agriculture. As the transmission lines get closer to the Bothell Substation, adjacent land uses also include suburban residential and transportation developments. Federal lands within the Project Boundary total 19,281.93 acres (FERC 2013).

The Skagit River downstream of the Project from Bacon Creek to Sedro-Woolley is part of the Skagit River Wild and Scenic River System, which is managed by the Mt. Baker-Snoqualmie District of the U.S. Forest Service (USFS). The NPS has deemed the Skagit River from Gorge Powerhouse to Bacon Creek eligible for status as wild and scenic, with the “recreational” classification, but this segment of the river is not yet designated (NPS 2012).

Skagit River Project dams, powerhouses, reservoirs, the two City Light-owned towns, and fish and wildlife mitigation lands are shown on the general location map in Figure 3.2-1, along with adjacent land ownership. Information on RM, township, range, and sections are listed in Table 3.2-1. Access to most of the Project is via State Route (SR) 20, commonly referred to as the North Cascades Highway. An overview map of the entire Project vicinity, displaying Project Boundary, including the Project transmission lines, Sauk and Marblemount boat launches, and fish and wildlife mitigation lands, township/range/section, state, county, river, RM, and closest towns, is provided in Figure 3.2-2. A detailed mapbook of the Project Boundary is appended to this PAD.

Table 3.2-1. Location data for the Skagit River Project.

Project Component	River Mile[1]	Township	Range	Section
Newhalem (town)	94	37N	12E	21 (SE ¼)
Gorge Powerhouse	94.3	37N	12E	21 (SE ¼)
Gorge Dam	96.5	37N	12E	14 (NW ¼)
Upstream end of Gorge Lake	99.8	37N	13E	6 (SE ¼)
Diablo (town)	100	37N	13E	5 (SW ¼)
Diablo Powerhouse	100.3	37N	13E	5 (SW ¼)
Diablo Dam	101	37N	13E	5 (SE ¼)
Upstream end of Diablo Lake	105	38N	13E	35 (SE ¼)
Ross Powerhouse	105	38N	13E	35 (SE ¼)
Ross Dam	105.3	38N	13E	35 (SE ¼)
Upstream end of Ross Lake in U.S.	127	41N	13E	35

1 River miles are approximate.

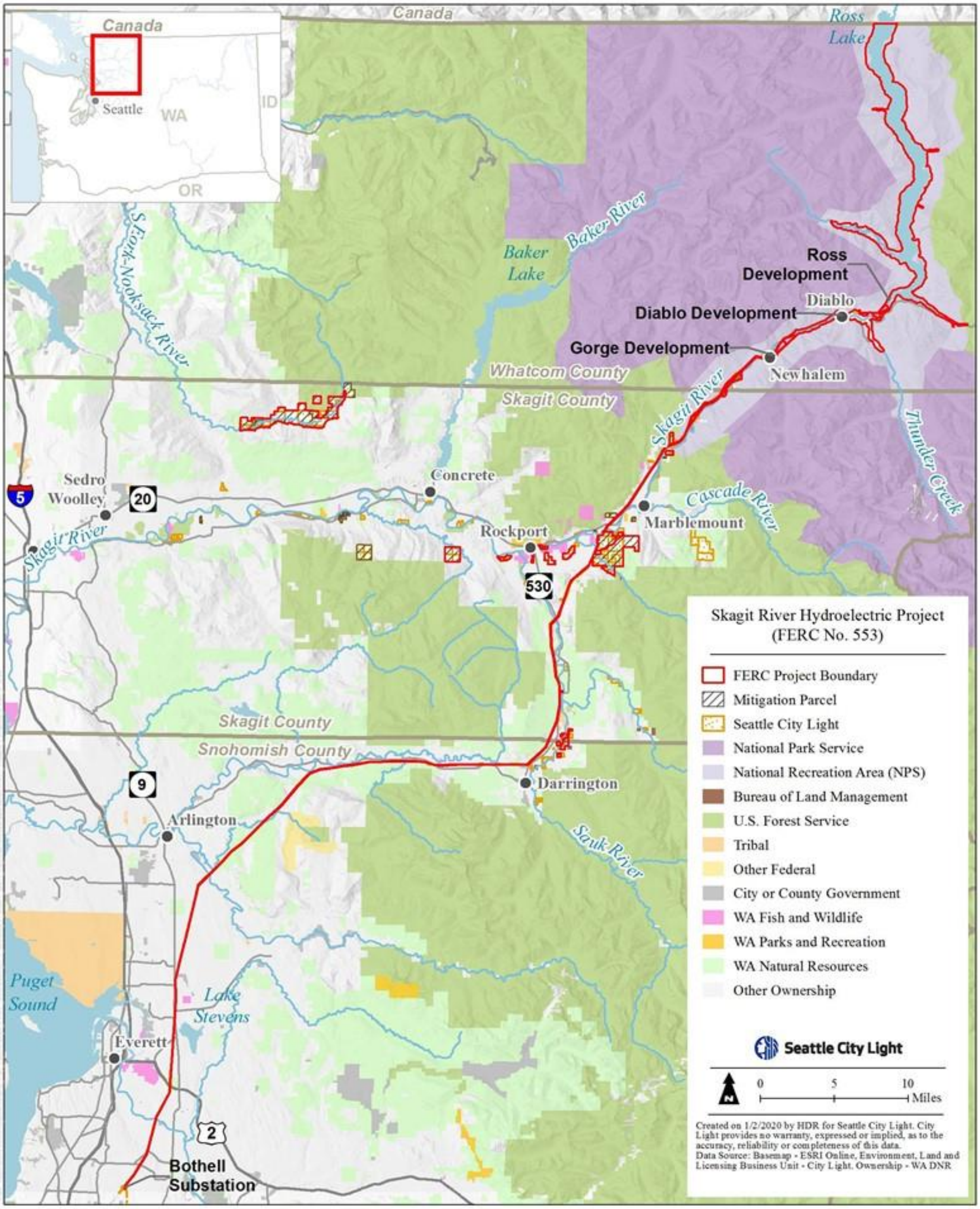

Figure 3.2-1. Location map of the Skagit River Project.

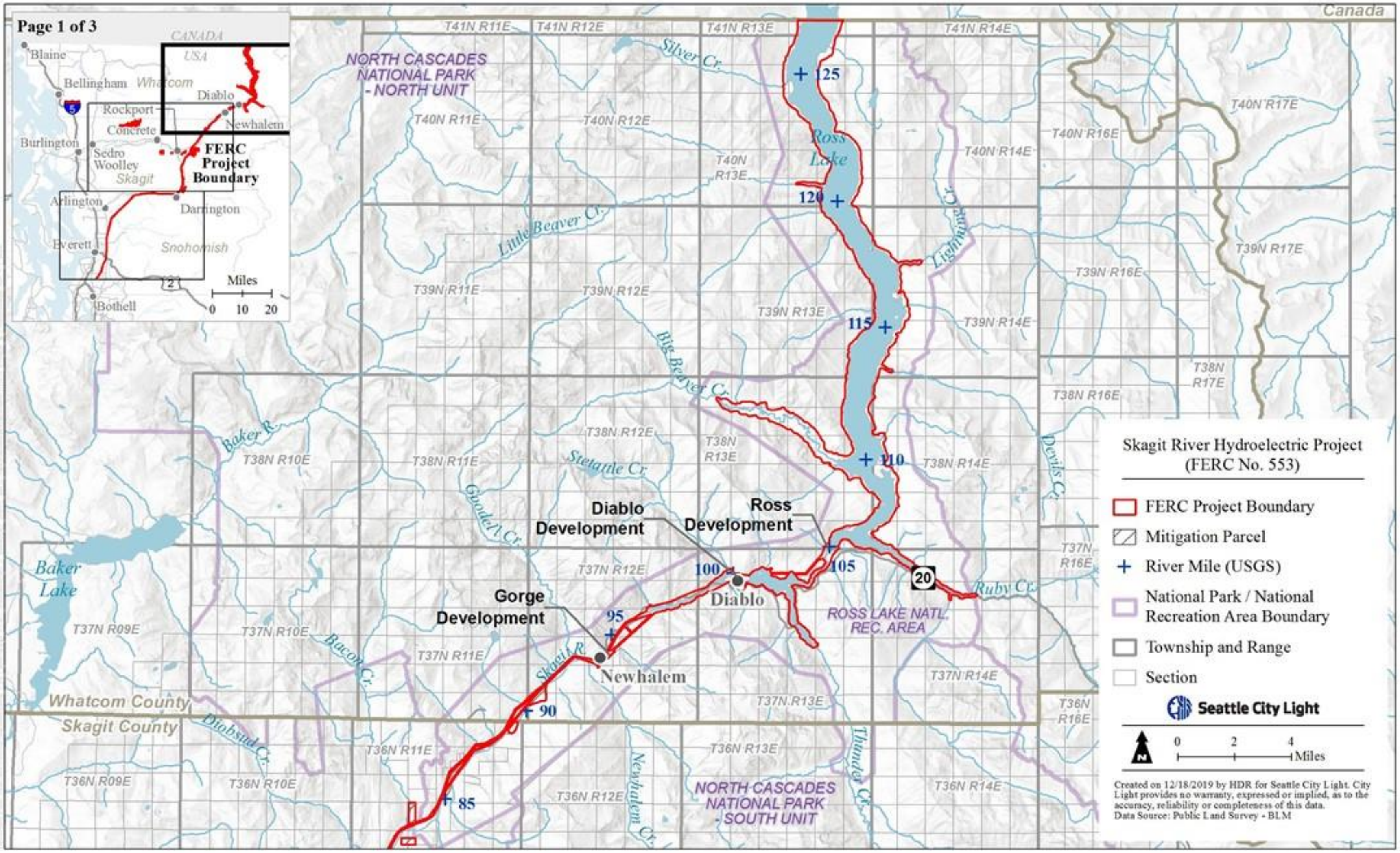

Figure 3.2-2. Skagit River Project and surrounding communities (page 1 of 3).

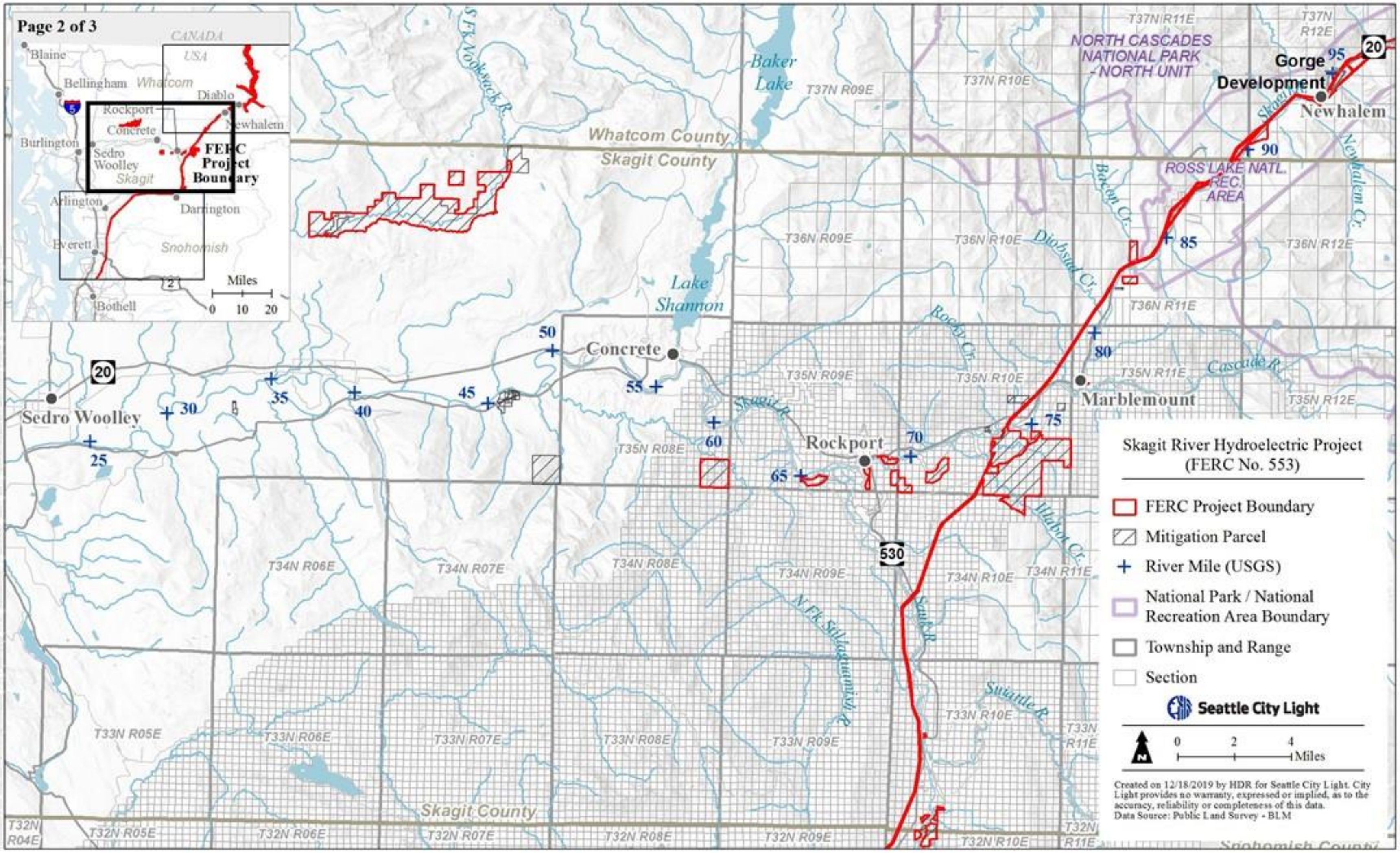

Figure 3.2-2. Skagit River Project and surrounding communities (page 2 of 3).

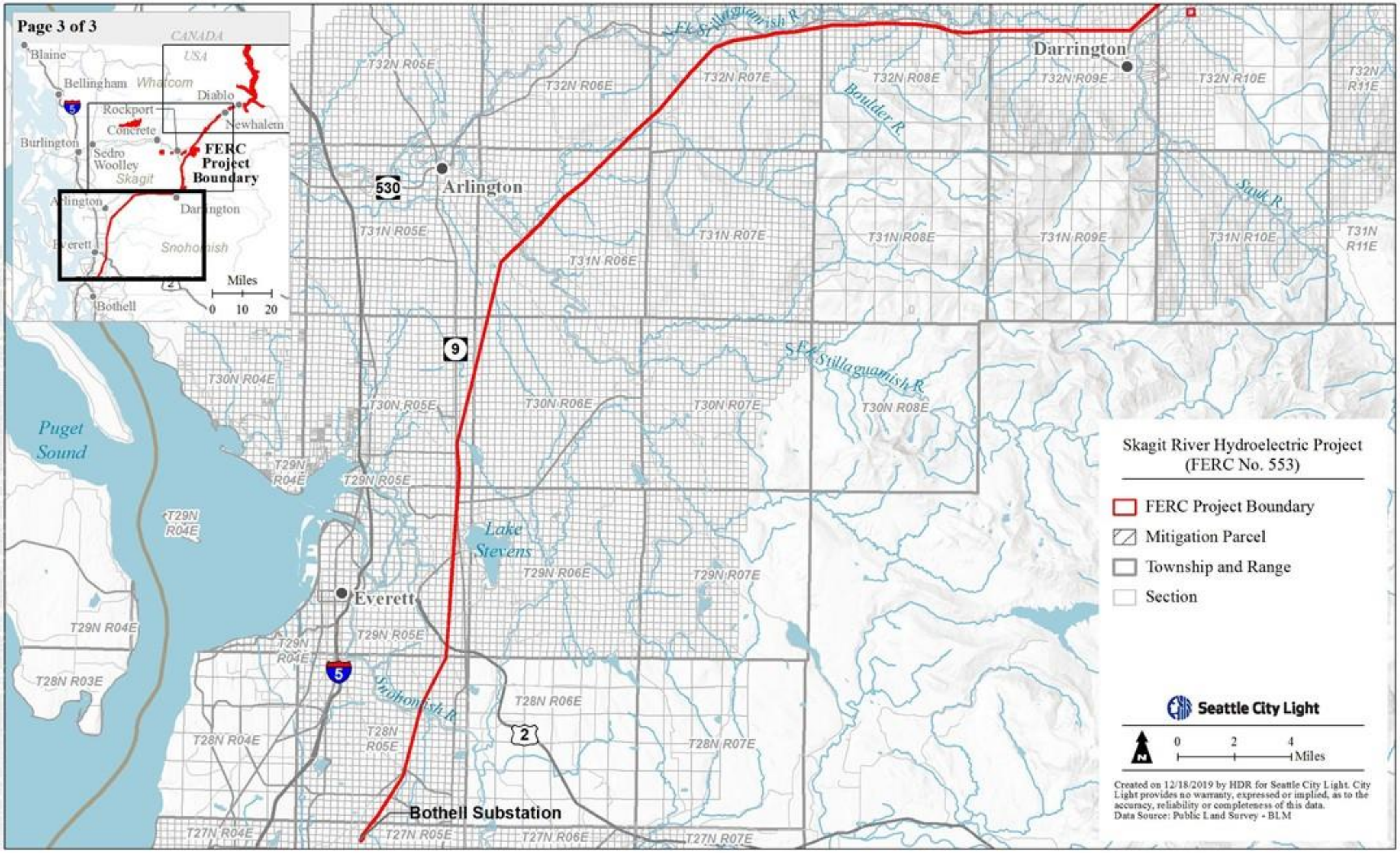

Figure 3.2-2. Skagit River Project and surrounding communities (page 3 of 3).

3.3 Project Construction Chronology

The City of Seattle received permission from the federal government to start developing hydroelectric generating facilities on the Skagit River on December 22, 1917. In 1919, the City's electrical utility, City Light, began constructing Gorge (timber crib) Dam and Powerhouse along with support facilities in what is now the town of Newhalem and a railroad to transport equipment, materials, and workers to the site. Gorge Powerhouse began generation in 1924. In 1927, FERC's predecessor, the FPC, issued the first license to the City of Seattle for the then-existing Gorge Development and the planned upstream Diablo Dam and Powerhouse. The construction of the Diablo Development was completed in 1936. Together, these facilities were licensed as the Skagit River Hydroelectric Project (Project No. 553).

Over the next 50 years (1927-1977), the FPC issued a series of license amendments that authorized Ross Dam and Powerhouse, as well as several improvements to the Project. Ross Powerhouse was completed in 1952. High Gorge Dam was completed in 1961. Plans to raise the height of Ross Dam by 125 feet, approved by the FPC in 1977, were suspended in 1985 with the signing of the High Ross Treaty in 1984. Development at the Project therefore concluded in 1961 with the construction of High Gorge Dam.

After the original license expired in 1977, City Light operated the Project under annual licenses during an 18-year relicensing period dedicated to scientific studies and negotiations with agencies, tribes, and other interested parties. This process culminated in the execution of a Settlement Agreement in 1991 between City Light and the 12 resource agencies, tribes, and NGOs which had intervened in the relicensing proceedings. The terms of this Settlement Agreement (City Light 1991) were incorporated into the current Project license, which was issued by FERC on May 16, 1995 for a term of 30 years and will expire April 30, 2025 (FERC 1995). The most recent major amendment to the current Project license was issued in 2013 authorizing the addition of a second power tunnel between Gorge Dam and Powerhouse (FERC 2013). The second power tunnel has not been constructed, however, and there have been no major modifications to the Project under the current license.

A summary of construction and license milestones for Project facilities and dates for other significant events in the history of the Project are provided in Table 3.3-1. More details on the 40-year construction history can be found in the Historic American Engineering Record (HAER 2000), Pitzer (2001), and the National Register of Historic Places (NRHP 2011).

Table 3.3-1. Summary of construction milestones and other significant events relating to operation of the Skagit River Project.

Year(s)	Event/Milestone
1917	Department of Agriculture gives permission for City Light to build dams on the Skagit River
1919	Work begins on Gorge Dam (timber crib) and Powerhouse
1920-21	Railway between Rockport and Newhalem constructed; the Department of Agriculture issues a permit for construction of the Gorge Dam (May 27)
1921	Work begins on Gorge power tunnel
1922	Clearing begins for 100 miles of transmission lines from Newhalem to Seattle
1924	Gorge Powerhouse, timber-crib dam, and power tunnel complete; one generator installed in powerhouse; transmission lines to Seattle finished; generation begins (September 14)

Year(s)	Event/Milestone
1926-27	Railroad extended to Diablo
1927	Work begins on Diablo Dam; FPC issues first license for the Skagit River Hydroelectric Project (No. 553) that includes the Gorge and Diablo plants (October 27)
1930	Diablo Dam finished
1931	Construction of Diablo Powerhouse begins
1932-34	All Diablo construction suspended
1936	Construction of Diablo Powerhouse completed; first generator installed; power generation begins (October 10)
1937	Amendment 1 to the Project license authorizes construction of Phases 1-3 of Ruby Dam. Phase 1 of Ruby Dam construction begins
1939	USFS completes a road from Rockport to Newhalem
1940	Phase 1 of Ruby Dam construction complete (to 300 feet high)
1942	City Light's planned Phase 4 for Ross Dam is approved by the International Joint Commission[1]; Phase 4 would raise the level of Ross Dam by 121 feet to a height of 661 feet (High Ross Dam)
1946	Ruby Dam construction resumes following World War II; minimum flows below Gorge Powerhouse established by Washington Department of Fisheries (WDF); Amendment 3 to Project license changes the name of Ruby Dam to Ross Dam in honor of J.D. Ross, long-time superintendent of City Light
1947	Under a contract with the WDF, City Light agrees to contribute $50,000 to build a fish hatchery at Marblemount and to maintain a minimum flow of 1,000 cubic feet per second (cfs) in the river below Gorge Powerhouse
1948	Construction of Ross Powerhouse starts; work begins on Gorge masonry dam and expansion of Gorge Powerhouse
1949	Phases 2 and 3 of Ross Dam completed (to 540 feet high)
1951	Gorge masonry dam and powerhouse expansion finished; timber dam removed
1952	Ross Powerhouse complete; first generator installed
1954-55	Skagit Railway is removed between Rockport and Newhalem
1957	Road extension from Newhalem to Diablo is complete; work begins on building High Gorge Dam
1961	High Gorge Dam complete
1962	Amendment 15 authorizes the construction of the Happy Creek-Ross Lake diversion tunnel
1967	City Light reaches agreement with British Columbia on compensation for building High Ross, which would flood an additional 4,750 acres in Canada
1968	North Cascades National Park and RLNRA are created
1970	City Light files an application with the FPC to amend the Project license to include construction of High Ross
1972	North Cascades Highway is completed and opened to the public; City Light begins automating the powerhouses
1977	Amendment 18 authorizes construction of High Ross; the original 1927 license expires; City Light files application for new license that includes raising the elevation of Ross Dam; Skagit River Project begins operating on annual licenses
1979	FERC (successor to the FPC) accepts the 1977 license application; 12 interested parties intervene in the relicensing proceedings
1980	British Columbia appeals the 1942 International Joint Commission decision for a second time
1981	City Light implements the Voluntary Interim Flow Agreement to reduce effects on fish downstream of Gorge Powerhouse

Year(s)	Event/Milestone
1984	Seattle and British Columbia reach agreement on High Ross; the High Ross Treaty is negotiated between the U.S. and Canada and extends to January 1, 2066; City Light agrees not to build High Ross in exchange for British Columbia providing an equivalent amount of power
1979-89	City Light conducts research studies to acquire information on Project effects for relicensing and negotiates with the intervenors
1985	City Light implements the Interim Flow Agreement to reduce effects on salmon in the Skagit River downstream of Gorge Powerhouse
1988	FERC issues an Additional Information Request (AIR) identifying specific issues requiring additional study
1989	City Light submits Supplemental Environmental Information to FERC in response to the AIR
1991	City Light files an Offer of Settlement with FERC that resolves all issues with the intervenors for the term of the new license
1995	FERC issues an Order Accepting Settlement Agreement, Issuing New License, and Terminating Proceedings (May 16); City Light and intervenors file a request for rehearing to correct technical problems in the Environmental Assessment and include all elements of the Settlement Agreement (June 14)
1996	FERC issues an order to incorporate all elements of the Settlement Agreement in the license (June 26)
2006	City Light completes the North Cascades ELC on Diablo Lake
2011	City Light files an application to amend the Project license to construct a second power tunnel between Gorge Dam and Powerhouse
2013	FERC issues an Order to Amend the License to include a second power tunnel at the Gorge Development; Order contains Reasonable and Prudent Measures identified in the Biological Opinions issued for listed fish species

1 The International Joint Commission was created by the Boundary Waters Treaty of 1909 to have jurisdiction over boundary water issues between Canada and the U.S.

3.4 Project Facilities

Total authorized installed capacity of the Project is 650.25 megawatts (MW); a revised Exhibit M updating the installed capacity to 805 MW is pending FERC's approval.[5] The Project supplies about 20 percent of the power needed to serve City Light's customer base. Each of the three Project developments, Gorge, Diablo and Ross, includes a dam, powerhouse, and reservoir, operations of which are hydraulically coordinated. The general layout of the developments relative to each other and components of each are shown in Figures 3.2-1 and 3.4-1 through 3.4-3, respectively. The Project powerhouses and dams and many associated structures are listed on the NRHP. Specifications for each development are summarized in Table 3.4-1 and described in detail below.

[5] The current authorized installed capacity of the Project is 650.25 MW (FERC 1997). In March 2020, City Light filed an updated Exhibit M, which upon approval by FERC, will increase the authorized installed capacity to approximately 805 MW.

Figure 3.4-1. Aerial view of Ross Development and associated facilities.

Figure 3.4-2. Aerial view of Diablo Development and associated facilities (not visible in photo: intake on right bank and valve house on face of the dam).

Figure 3.4-3. Aerial view of Gorge Development and associated facilities (not visible on photo: log chute on face of dam, Gorge Powerhouse, and surge tank about 2.5 miles downstream of the dam).

Table 3.4-1. Specifications for the three developments of the Skagit River Project.

Project Component	Development		
	Gorge	Diablo	Ross
Dam			
Composition and configuration	concrete arch gravity diversion	concrete arch	concrete arch
Structural height of dam	300 feet (ft)	389 ft	540 ft
Length of crest (including spillways)	670 ft	1,180 ft	1,300 ft
Dam thickness at base	170 ft	146 ft	208 ft
Dam thickness at roadway	70 ft	16 ft	33 ft
Elevation of crest of dam (at roadway)	880.5 ft[1]	1,218 ft	1,615 ft
Concrete volume:	Unknown	350,000 cubic/yards	909,214 cubic/yards
Spillway			
Number of spillways	1	2	2
Spillway gates: Number Type Dimensions	 2 Fixed wheel 50 ft high by 47 ft wide	 19 Radial Tainter 19 ft high by 20 ft wide	 12 Radial Tainter 20 ft high[2] by 19.5 ft wide
Spillway crest elevation	825 ft	1,187 ft	1,582 ft
Maximum spillway capacity (at normal maximum water surface elevation)	120,000 cfs	98,500 cfs	124,800 cfs
Reservoir			
Normal maximum water surface elevation	875 ft	1,205 ft	1,602.5 ft
Maximum drawdown (authorized by current Project license)	825 ft	1,198 ft	1,474.5 ft
Length of reservoir	4.5 miles	4.5 miles	24 miles[3]
Surface area at normal maximum water surface elevation	240 acres	770 acres	11,680 acres[3]
Shoreline length at normal maximum water surface elevation[4]	11 miles	20 miles	84 miles[5]
Gross storage	8,500 acre-ft	50,000 acre-ft	1,435,000 acre-ft[6]
Usable storage	6,600 acre-ft	8,820 acre-ft	1,052,000 acre-ft
Intake			
Intake structure	1 bifurcated intake with 2 openings, each 20 ft wide and 88.9 ft long (4:1 vertical:horizontal incline)	2 bifurcated intakes with 4 openings, each 16.75 to 18.75 ft wide and 153.17 ft long (approximate 2.6:1 vertical:horizontal incline)	2 bifurcated intakes with 4 openings, each 20 ft wide and 198.13 ft long (4:1 vertical:horizontal incline)

Project Component	Development		
	Gorge	Diablo	Ross
Trashrack opening	3.5 inches by 2 ft and 2.5 inches	2.5 inches by 2 ft and 0.3 inches	3.5 inches by 2 ft and 1 inch for three rows per panel and 3.5 inches by 2 ft and 5.5 inches for one row per panel
Intake ("power") tunnel:			
Number	1	1	2
Invert elevation	795 ft	1,080 ft	1,423 ft
Length of concrete-lined section (gate slot to steel liner)	11,000 ft	1,800 ft	1,800 ft/1,634 ft
Length of steel-lined section	NA	190 ft	NA
Diameter of concrete-line section	20.5 ft	19.5 ft	24.5 ft
Diameter of steel-lined section	NA	19.5 ft	NA
Penstocks:			
Number	4	4	4
Length	1,600 ft	290 ft	350 ft
Diameter of turbine inlet	10 ft (Units 21, 22, 23); 15 ft (Unit 24)	15 ft (Units 31, 32); 5 ft (Units 35, 36)	16 ft (all units)
Penstock centerline elevation at turbine inlet	497 ft	881 ft	1,211.5 ft
Powerhouse			
Total plant capability[7]	207.58 MW	182.4 MW	450 MW
	839.98 MW total		
Total authorized installed capacity[7,8,9]	173 MW	182.4 MW	450 MW
	805.4 MW total		
Annual capacity factor	51.83%	47.99%	13.35%
Normal tailwater elevation at dam	495 ft	875 ft	1,205 ft
Normal gross head	380 ft	330 ft	374 ft
Turbines:			
Turbine type	Francis vertical	Francis vertical	Francis vertical
Number of units	4	4	4
Ratings (hp=horsepower; RPM=rotations per minute)	Units 21, 22: 42,242 hp at 380 ft head, 257 RPM Unit 23: 43,180 hp at 380 ft head, 257 RPM Unit 24: 139,400 hp at 380 ft head, 150 RPM	Units 31, 32: 117,200 hp at 330 ft head, 171.5 RPM Units 35, 36: 1,650 hp at 330 ft head, 720 RPM	140,000 hp at 337 ft head, 150 RPM
Hydraulic capacity (at maximum plant output)	7,440 cfs	7,130 cfs	16,000 cfs

Project Component	Development		
	Gorge	Diablo	Ross
Generators:			
Generator manufacturer	Westinghouse	Westinghouse	Westinghouse
Ratings	U21 36.86 MW U22 36.86 MW U23 36.86 MW U24 97.00 MW	U31 90 MW U32 90 MW U35 1.2 MW U36 1.2 MW	U41 112.5 MW U42 112.5 MW U43 112.5 MW U44 112.5 MW
Plant factor (average)	107.59 MW	87.53 MW	60.10 MW

Source: Power System Engineering Information 2019 (City Light 2019).

1 All elevations in the table are City of Seattle Datum.
2 2.5-feet risers installed on top of each gate to increase storage capacity by 30,000 acre-feet and annual energy capability by 10,700 megawatt hours (MWh).
3 Approximately 23 miles and 11,180 acres in the U.S. and 1 mile and 500 acres in Canada.
4 Shoreline length calculated from Light Detection and Ranging (LIDAR) data collected in 2018 that is in North American Vertical Datum of 1988 (NAVD 88) datum.
5 Approximately 369,315 ft (69.9 miles) in U.S. and 75,742 ft (14.3 miles) in Canada. Shoreline length in Canada includes small channels and inlets with shallow water.
6 U.S. Geological Survey (USGS) uses 1,440,700 acre-feet as the capacity of Ross Lake.
7 These numbers are consistent with a revised Exhibit M filed with FERC in March 2020. At the time of publication, FERC approval has not been received. The authorized installed capacity is 650.25 MW (FERC 1997).
8 Generating capacity is limited to 173 MW at Gorge by head loss from tunnel capacity. In addition, Units 21, 22, and 23 at Gorge are restricted to a combined maximum of 96 MW due to water and generator bus limitations.
9 The small "house" units (35 and 36) at Diablo provide power to only the town, the powerhouse, and the ELC.

3.4.1 Ross Development

The Ross Development is the furthest upstream of the three Skagit River Project developments; the powerhouse and nearby dam are about 11 miles north of Newhalem (Figures 3.2-1 and 3.4-1). Most of the water used for Skagit River Project power generation originates in high mountain basins surrounding Ross Lake and upstream along the Skagit River in British Columbia. The Ross Development has no direct road access; all materials, equipment, and staff are transported by boats and barges from a boathouse/dock/landing area at the western side of Diablo Lake to a dock/landing near Ross Powerhouse. A gravel "haul" road (Ross Haul Road) connects the powerhouse and dock/landing to the dam. This road continues upstream of Ross Dam for approximately 1.6 miles providing access to a landing used by Ross Lake Resort and other activities. The only other access to the development is via two foot trails – one off SR 20 at milepost (MP) 134 and another that runs along the north side of Diablo Lake, crosses via a suspension bridge and connects to the Ross Haul Road.

Ross Powerhouse is about 1,100 feet downstream of Ross Dam, on the south side of Diablo Lake (Figure 3.4-4). It was completed in 1952 and operated with a single generator that year. Additional generating units were added in 1953, 1954, and 1956, for a total of four, all manufactured by Westinghouse (Units 41, 42, 43, and 44), and each with a current authorized installed capacity of 112.5 MW (Table 3.4-1). Two concrete-lined power tunnels deliver water from the reservoir to four penstocks and into the powerhouse. There is no surge tank. Diablo Lake backs up to the base of Ross Dam and there is no bypass reach or section of free-flowing river between the two developments.

Figure 3.4-4. Ross Powerhouse.

Ross Dam is just upstream of Ross Powerhouse at RM 105.3. At 540 feet from bedrock to crest, it is the highest of the three Project dams. The dam was built in three phases over a period of 12 years and was completed in 1947. It has a unique waffle construction and was designed to be 121 feet higher. Plans to build "High Ross" Dam were suspended in 1984 with the signing of the High Ross Treaty between the governments of the U.S. and Canada; the treaty extends to January 1, 2066.[6]

Ross Dam has two spillways, one on each side and each with six gates operated by an electric hoist (Figure 3.4-5). Two of the spill gates can be controlled remotely; the others are operated locally at the dam. In addition to the spillways, Ross Dam has two power tunnel intake structures, two butterfly valves at the 1,340-foot level and two hollow jet valves near the base (1,269 and 1,254 feet elevation). The two sets of valves can be opened to evacuate the reservoir once water levels drop below the level of the spill gates. On the top of the dam, a shed houses two hoists, one for each of the broome gates that close off the six-foot-diameter water supply pipes to the hollow jet valve. There is also a gantry which is used to raise and lower the broome gates that isolate the six-foot pipes for the butterfly valves. The road on top of the dam is used by City Light and NPS vehicles and is open to pedestrian use by the public.

[6] For more information on the High Ross Treaty see: https://www.nps.gov/parkhistory/online_books/noca/adhi/chap7.htm; https://skagiteec.org/about/high-ross-treaty/ and http://www.treaty-accord.gc.ca/text-texte.aspx?id=100403.

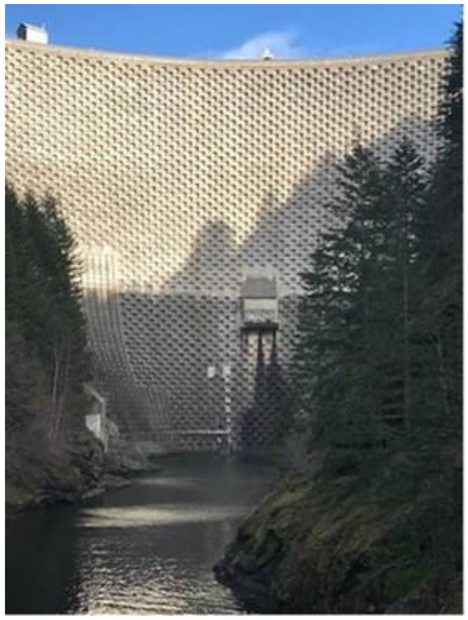

Figure 3.4-5. Ross Dam.

At nearly 23 miles long, Ross Lake is the largest reservoir in western Washington. It extends into Canada approximately another 1 mile (24 miles total), with about 500 acres in British Columbia. The reservoir has a surface area of 11,680 acres and storage volume of 1,435,000 acre-feet at the normal maximum water surface elevation of 1,602.5 feet. With a drainage basin of 381 square miles (sq. mi.) in British Columbia (USGS 2019), the Skagit River provides the greatest inflow into Ross Lake. There are, however, several other tributary streams that make significant contributions. These include Ruby, Lightning, and Big Beaver creeks which drain 209, 133, and 64 sq. mi., respectively (USGS 2019). Several other smaller streams contribute as well, including Happy Creek which was diverted (circa 1962) via a tunnel into the reservoir from its original confluence with the Skagit River below the powerhouse.

Ross Lake is relatively inaccessible, especially by vehicle. The only vehicle access is via a 40-mile-long, gravel road from Hope, British Columbia, to Hozomeen at the very north end of the reservoir (Figure 3.4-6). The boat ramps at Hozomeen provide the only public launches for motorized boats. The reservoir can also be accessed by foot via the Ross Dam Trail, which is one mile long and drops 700 feet from a parking lot along SR 20 at MP 134. Another trail to the lake, the East Bank Trail, leaves SR 20 from the upper end of Ruby Arm.

Figure 3.4-6. Ross Lake near Hozomeen looking north into British Columbia.

3.4.2 Diablo Development

The Diablo Development is between the Ross and Gorge developments (Figures 3.2-1 and 3.4-2) and in addition to generating power, it reregulates flows between the other two developments. The powerhouse is on the north bank of the Skagit River in the town of Diablo, about 4,000 feet downstream from Diablo Dam. Water from the reservoir to the powerhouse is conveyed by a single tunnel that leads to three penstocks. There is a surge tank located near the bottom end of the tunnel, uphill from the powerhouse. The dam is accessed by Diablo Dam Road which connects to SR 20 at MP 127.5; the powerhouse is in the town of Diablo and reached by a spur road off SR 20 at approximately MP 125.

The powerhouse was completed in 1936 and holds two Westinghouse generators (Units 31 and 32), each with current authorized installed capacities of 90 MW and two smaller, house-unit generators (Units 35 and 36), with capacities of 1.2 MW each (Figure 3.4-7; Table 3.4-1). A reinforced-concrete tailrace on the westerly edge of the powerhouse also serves to support transformers, a switching apparatus, and a crossing for a single-lane road. Designed to be a showpiece for the Project, Diablo Powerhouse also includes a visitor gallery, pedestals to elevate the generators, decorative tile walls, terrazzo floors, and a goldfish pond (Figure 3.4-8).

Figure 3.4-7. Diablo Powerhouse.

Figure 3.4-8. Diablo Powerhouse visitor gallery.

Diablo Dam, located at RM 101, is about five miles upstream of Gorge Dam and four miles downstream of Ross Dam (Figure 3.4-9). The concrete arch dam is 389 feet from bedrock to crest; when completed in 1930, it was the highest thin-arch dam in the world. The Art Deco design includes decorative arches over the spillways and lighting on the crest of the dam.

Figure 3.4-9. Diablo Dam.

Diablo Dam has two spillways, one on each side, and a total of 19 spill gates (Figure 3.4-2), 7 on the south spillway and 12 on the north. The three southern-most gates are automated via an electric hoist that can be operated remotely or locally. The remaining 16 gates are controlled locally at the dam using the “mule,” an electric motor-driven hydraulic pump that operates two hydraulic cylinders to open or close the associated spill gate. The mule runs on tracks along the road on top of the dam and is positioned over the desired gate. The lifting chains for the gates are accessed below the deck plates on the dam. A valve house on the face of the dam at elevation 1,047 feet has four outlet valves—three butterfly type and one Larner Johnson type—that can evacuate water from the reservoir at levels below the spill gates. There are two bifurcated intakes at the dam but only one is in use as the second intake was for planned future expansion of the powerhouse, including a second tunnel, which were never constructed. The crest of the dam also serves as a road that is open to the public during the day and provides access to City Light facilities, including the ELC, and RLNRA lands on the west side of Diablo Lake.

Diablo Lake has a surface area of about 770 acres and gross storage of 50,000 acre-feet at a normal maximum water surface elevation of 1,205 feet (Figure 3.4-10). Access to Diablo Lake is relatively limited because of the steep, rocky slopes that abut much of the shoreline. Tributaries to Diablo Lake include Thunder, Colonial, Rhode, Sourdough, and Deer creeks. Four of these five creeks are relatively small with short, steep drainage areas. Thunder Creek, however, drains a large area in one of the most heavily glaciated basins in the lower 48 states. During the summer, Thunder Creek carries a heavy load of very fine, suspended glacier-generated sediment, also known as glacial flour, which gives the lake a notable turquois color.

Figure 3.4-10. Diablo Lake from overlook east of Colonial Creek Campground.

3.4.3 Gorge Development

Gorge Powerhouse is on the left bank (facing downstream) of the Skagit River just upstream of the town of Newhalem (Figures 3.2-1 and 3.4-3) and is reached via a bridge across the river that connects to SR 20. The original powerhouse, which was completed in 1924 (Figure 3.4-11), had two Westinghouse generators (Units 21 and 22); an additional unit (Unit 23) was added in 1929. The powerhouse was expanded in 1949, and in 1951, a fourth unit was added (Unit 24). The three older units have current authorized installed capacities of 36.86 MW each; Unit 24 is significantly larger, with a current authorized installed capacity of 97 MW (Table 3.4-1). The powerhouse also includes a visitor gallery, with views onto the powerhouse floor, and a small museum with exhibits on hydroelectric power generation and the history and operation of the Project (Figure 3.4-11).

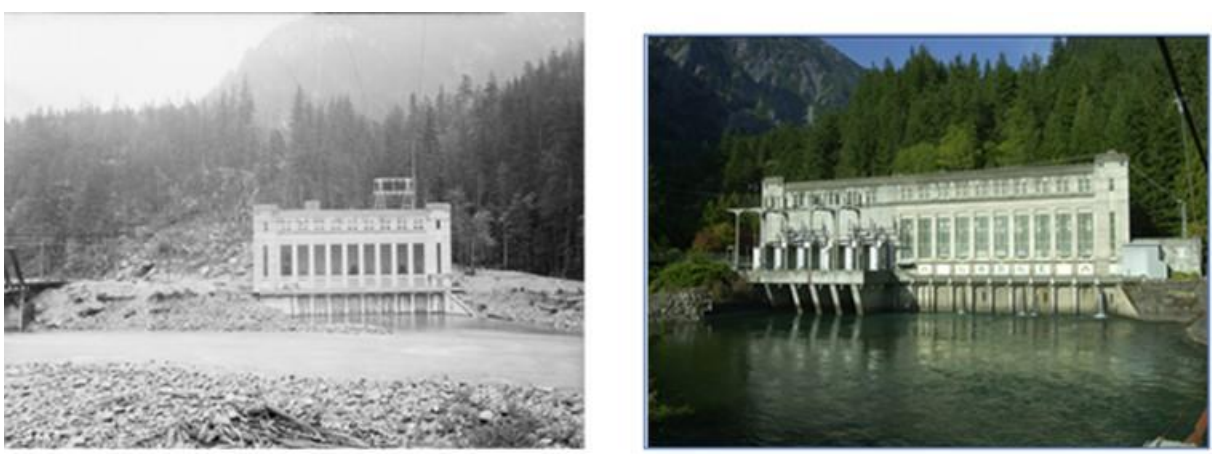
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Figure 3.4-11. Gorge Powerhouse, 1926 and today.

In addition to generating power, Gorge Powerhouse is responsible for regulating flows to the river downstream of the Project for fish protection, as stipulated by the current Project license. Units 21, 22, and 23 are each connected to penstocks through 10-foot-diameter, biplane-type butterfly valves equipped with relief valves, which will discharge a maximum of 65 percent of the turbine flow at full-load rejection. Equipment has also been installed to allow these valves to open and stay open for any required period to maintain fish flows after a plant load rejection/shutdown. Unit 24 is connected to the penstock through a 15-foot-diameter butterfly valve.

Water from Gorge Lake is conveyed via an intake structure in Gorge Dam into an 11,000-foot-long power tunnel to the powerhouse. The power tunnel passes through the solid rock slope that is adjacent to the Skagit River and then splits into four penstocks. A surge tank and riser with restricted orifice is located at the lower end of the tunnel. There are also two adits that provide access to the power tunnel—one about halfway at Devil's Elbow and the other near Gorge Powerhouse. A second power tunnel at the Gorge Development was authorized in a license amendment issued by FERC on July 17, 2013. While not yet constructed, the new tunnel would be 11,000 feet long and 22 feet in diameter and would be below ground and parallel to the existing tunnel. The new tunnel would not change the installed capacity of the Gorge Development; it would, however, increase plant efficiency and would be expected to produce an additional 56,000 MWh annually.

Gorge Dam, located at RM 96.5, is about 2.5 miles upstream of Gorge Powerhouse and 4 miles downstream from Diablo Dam near Gorge Creek. It is accessed via a spur road off SR 20, at about MP 122, which is gated at a bridge over the river and not open to the public. The current Gorge Dam, which was completed in 1961, is a combination concrete arch and gravity structure that rises 300 feet from bedrock to crest (Figure 3.4-12). There have been two other Gorge dams—a timber-crib dam, built in 1923-1924 and a masonry dam, finished in 1951. The timber-crib dam was removed after construction of the masonry dam. Water from the current dam inundated the earlier masonry dam, which was much lower.

Figure 3.4-12. Gorge Dam.

The existing dam has a log chute which allows wood to be passed downstream of the Project. There are two spillways with gates that are operated by an electric hoist on top of the dam. One gate can be remotely controlled to a limited height; the other must be opened and closed locally at the dam. Training walls on either side of the spillway direct water into the river channel downstream. Two outlet valves on the face of the dam at elevation 764 feet can be used to evacuate water from Gorge Lake below the spill gate level.

Gorge Lake is 4.5 miles long and extends to the base of Diablo Dam. At the normal maximum water surface elevation of 875 feet, the lake has a surface area of 240 acres and gross storage of 8,500 acre-feet. Under normal operations at both the Gorge and Diablo developments there is a short section of free-flowing river between the Diablo tailrace and the upper end of Gorge Lake. Stetattle Creek, the only significant tributary to Gorge Lake, enters the Skagit River in this area. Although visible from SR 20, which runs along the north side, the reservoir is relatively inaccessible because of its location in a steep rocky canyon.

The reach of the Skagit River between Gorge Dam and Powerhouse is referred to as "the bypass reach" and is about 2.5 miles long.[7] The Project Boundary does not include the bypass reach except for areas that overlap the transmission lines. Under the current Project license, City Light is not required to release any flow into the Gorge bypass reach. Except when water is being spilled at Gorge Dam, flows in the bypass reach are limited to accretion flow, spill-gate seepage, tributary input, and precipitation runoff. Much of this reach is upstream of several natural barriers to anadromous fish passage; the most downstream of these barriers is located 0.5 miles upstream of Gorge Powerhouse at RM 95 (Smith and Anderson 1921). Because of these natural barriers to fish passage, there are no fish screens or passage facilities at Gorge Dam or either of the upstream dams.

3.4.4 Townsites

The Skagit River Project is in a remote location and includes two small towns that provide the facilities and support services needed for Project operations and maintenance (O&M). Both towns were originally built to provide housing and services to the workers constructing the Project, which numbered in the hundreds, depending on the year. About 25 of the 88 full-time employees who currently work at the Skagit River Project live in the two towns. Some of the houses are used as temporary lodging for contractors and City Light staff who normally work elsewhere and seasonal workers; others are rented to seasonal staff working for NPS and the North Cascades Institute (NCI). Most of the buildings remaining in the two towns are on the NRHP.

Newhalem is located between SR 20 and the Skagit River, just downstream of Gorge Powerhouse (Figures 3.2-1 and 3.4-13). The northern portion of the town is occupied by Gorge Switchyard and a large maintenance yard with warehouses, storage buildings, and shops. The remainder of the town includes 28 houses, two bunkhouses, garages, administrative offices, a meeting hall, a dining hall, a playground, a firehouse, a wastewater treatment plant, a general store, an information center, parking lots, and public restrooms. Heading from west to east on SR 20, Newhalem is the last town for 70 miles and a frequent stop for travelers and visitors to RLNRA. In addition, two popular recreation sites are accessed from Newhalem—Trail of the Cedars and Ladder Creek Gardens. Under the current Project license, a variety of visitor services were added in Newhalem, including

[7] Previous documents note the bypass reach length is 2.7 miles. Current calculations by City Light (2019) show 2.5 miles.

expanded restrooms, an information center, parking, electric vehicle charging stations, and interpretive signs. All land occupied by Newhalem is owned by City Light.

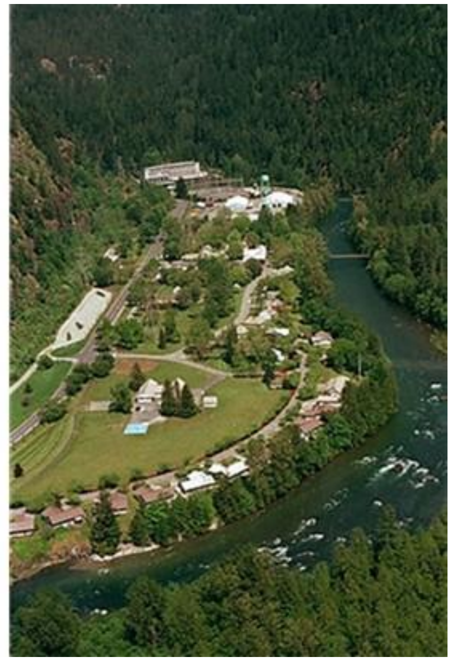

Figure 3.4-13. Newhalem, 1928 and today.

Diablo is about six miles north of Newhalem and one mile off SR 20. Diablo Powerhouse and Switchyard are in the middle of the town (Figure 3.2-1), dividing it into two sections—one known as Hollywood and the other as Reflector Bar (Figure 3.4-14). Reflector Bar is located on federal lands managed by NPS; City Light owns the Hollywood area. Hollywood is primarily residential, with 23 houses, nearly all built in the 1950s. Reflector Bar consists of 12 similarly-aged houses, a warehouse, several buildings used for administrative and maintenance purposes, and a water tower. An incline lift, which was used to carry workers, visitors, and train cars full of equipment from Diablo up the steep slope to the elevation of Diablo Lake, is immediately adjacent to Reflector Bar and is no longer operable. The houses on Reflector Bar are not on the NRHP and are not used by Project staff. They are scheduled to be torn down by the end of 2020, with the land restored to native habitat in coordination with NPS.

Figure 3.4-14. Reflector Bar area of Diablo, circa 1935 and today.

3.4.5 Transmission

The Project Boundary includes approximately 351.83 circuit miles of transmission lines that can carry the entire load from the Project to Seattle. The lines terminate at Bothell Substation, just north of Seattle; the substation is located partially within the Project Boundary. The other substation associated with the line is North Mountain, outside of Darrington, which is jointly owned by City Light and Snohomish Public Utility District and began operations in 1991. This substation gives City Light the ability to interconnect with other utilities to balance regional supply and demand, if needed. It is not a Project facility and is not within the Project Boundary.

The Project transmission lines are primarily on double-circuit steel lattice towers, although a few towers have been replaced with monopoles. The various components of this system are described below, and a schematic is provided in Figure 3.4-15.

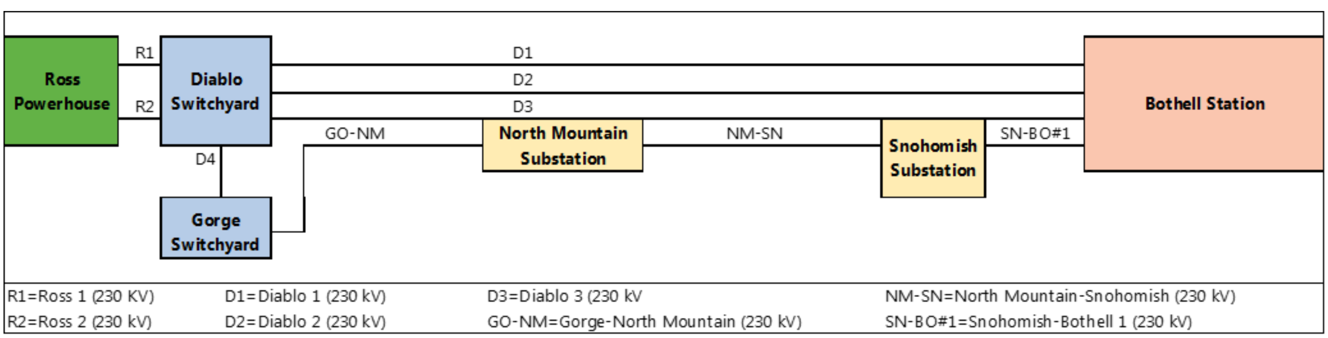

Figure 3.4-15. Transmission single-line diagram.

- From Ross Powerhouse, two 230-kV transmission lines (R1 and R2) run for about 3.8 miles along the west side of Diablo Lake, down the hillside past Diablo Dam to Diablo Switchyard.
- The 230-kV Diablo Switchyard is adjacent to Diablo Powerhouse and serves to connect the Ross, Diablo, and Gorge developments into the Skagit transmission system (Figure 3.4-16). The R1 and R2 lines from Ross terminate at the switchyard.

Figure 3.4-16. Diablo switchyard.

- From Diablo Switchyard, one 230-kV line (D4) runs for 5.8 miles and terminates at Gorge Switchyard, located just across the river from Gorge Powerhouse. The other three lines (D1, D2, and D3) run 87.5 miles to the Bothell Switching Substation.
- From the 230 kV Gorge Switchyard, a single 230-kV line (GO-NM) runs 36.8 miles to the North Mountain Substation.
- From there, the NM-SN line extends for 40.6 miles to Bonneville Power Administration's (BPA) Snohomish Substation and then another 7.6 miles to Bothell as SN-BO#1.

From Gorge Switchyard to North Mountain Substation the D1, D2, D3, and GO-NM lines are mostly within the same ROW, although there are a few sections where the ROW splits, with two lines in each, due to topographical constraints. At the North Mountain Substation, the NN-SN line joins the three lines originating at Diablo (D1, D2 and D3) and runs in the same ROW. Similarly, the SN-BO#1 line joins the ROW from the Snohomish Substation to Bothell. From Ross Powerhouse to Bothell Substation, the ROW is approximately 100 miles long and ranges from 150 to 400 feet wide.

3.4.6 Transportation Infrastructure

Current transportation infrastructure at the Project includes roads, marine facilities, and helipads. The marine facilities and helipads are displayed in Figure 3.4-17. The railway that was constructed for the Project was dismantled in 1954. The incline lift that carried rail cars, equipment, and personnel from Diablo (Reflector Bar) up the hillside to Diablo Lake still exists though is no longer functional.

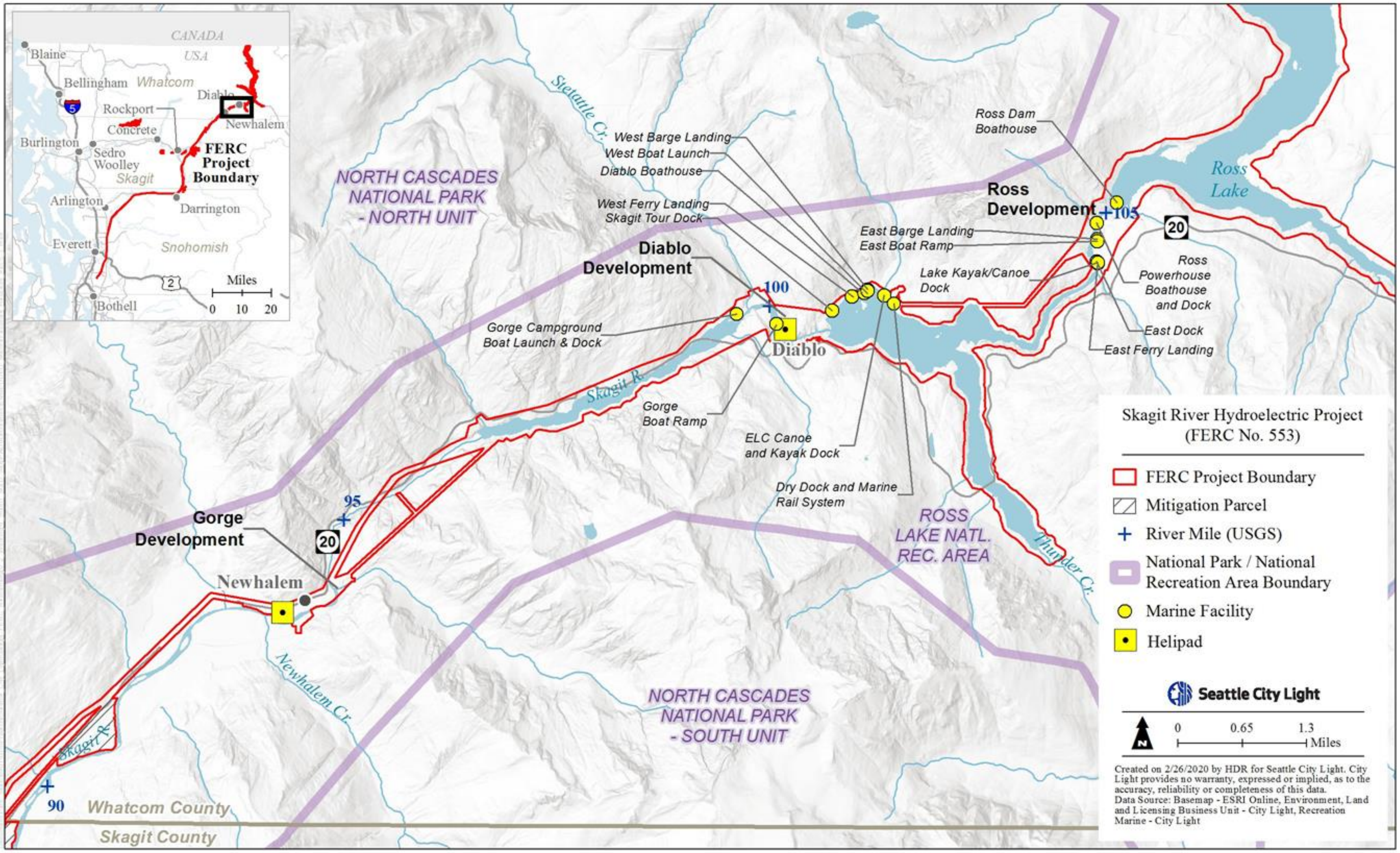

Figure 3.4-17. Helipads and marine facilities for the Skagit River Project.

3.4.6.1 Access Roads

Up until the early 1940s, the Project was accessible only by rail. USFS constructed a dirt road to Newhalem which was gradually improved and eventually extended to Diablo. Today, the main Project access is via SR 20, the northern-most, cross-state highway, which was completed in 1972. This road, which is maintained by the Washington State Department of Transportation (WSDOT), is closed in the winter (usually from November through April) on both the west and east sides of the Cascades due to heavy snow and avalanches. The typical closure site on the west side is at the trailhead to Ross Lake (MP 134), but there are also gates at the bridge over Thunder Arm and at Newhalem. In most years, avalanches close the section of highway between Newhalem and Diablo at least once or twice.

The only vehicle access to the north end of Ross Lake is via the Silver-Skagit Road, a gravel road which starts in Hope, British Columbia, and extends for approximately 40 miles until it terminates at the U.S.-Canada border. The Silver-Skagit Road provides access to recreational facilities in Skagit Valley Provincial Park and transitions into an unnamed road network at Hozomeen within RLNRA which is used by recreationists, the NPS, and City Light crews. The Silver-Skagit Road is closed from November through April of each year.

Most of the roads associated with the generation facilities and townsites were constructed and are maintained by City Light. These include the following:

- All roads within the towns of Newhalem and Diablo (paved);
- The roads to Gorge Powerhouse (paved, gated) and Dam (gravel/dirt surface, gated);
- Diablo Dam Road (paved);
- A short, spur road from Diablo Dam to the top of the Incline Lift (paved);
- The road to Babcock Communications Tower (gravel/dirt surface, gated);
- The road from Ross Powerhouse to Ross Lake (aka the “Ross Haul Road,” gravel surface) and associated tunnel;
- Two spur roads off the road to Ross Lake – one to a ferry landing and the other to Ross Dam (gravel surfaces); and
- Road to the storage area at Newhalem Ponds (aka “Agg Ponds”) and associated spur roads to ponds and river (gravel/dirt surface, gated).

Although City Light uses all these roads for Project operations, most are also used by other parties, including recreationists and NPS and NCI staff. Diablo Dam Road and portions of the Ross Haul Road, in particular, receive substantial use by the public to access water-based recreation and NPS trailheads. Babcock Creek Road, in addition to providing access to City Light microwave and radio systems, is also used by five other entities with communication equipment on Babcock ridge. City Light also constructed and maintains some roads to access the transmission lines. City Light is in the process of documenting all roads used for transmission line access and will submit this information in the license application.

3.4.6.2 Helipads

There are two helipads at the Project—one in Newhalem and the other on Reflector Bar in Diablo (Figure 3.4-17). The Newhalem helipad is routinely used in the winter by contractors conducting snow surveys. During times when SR 20 is closed at Newhalem, helicopters shuttle staff and supplies to Diablo where they can then be transported to Ross Lake or other upriver facilities as needed. There is also a designated helicopter landing area in a cleared area near Ross Dam, but this is only used in emergencies.

3.4.6.3 Marine Facilities

Given the relatively limited access to the Project reservoirs, a variety of marine facilities and boats are required to support generation operations. The location of marine facilities is shown in Figure 3.4-17.

The bulk of City Light marine facilities are located on Diablo Lake because it is the primary means of accessing the Ross Development. All materials, vehicles, and staff needed at Ross Powerhouse or Dam travel by boat. In addition, the current Project license requires that City Light provide a ferry service for public access to Ross Lake. The marine facilities on Diablo Lake are clustered in two locations (Figure 3.4-17):

- North shoreline at the west end of Diablo Lake and accessed by Diablo Dam Road:
    - Skagit Tour Dock – Used to support public boat tours of Diablo Lake offered by City Light during the summer months.
    - West Ferry Landing – Provides public access via a ferry to the east end of Diablo Lake, typically from mid-June through October.
    - Diablo Boathouse – Provides covered slips and dock moorage for City Light's boats on Diablo Lake which include one to three tug boats, two crew boats, a ferry boat, and a tour boat. This structure also contains the offices for the boat crews and space for maintenance and storage. There is also an adjacent fueling dock.
    - West Barge Landing – Used to load and unload barges of materials going to/from Ross Powerhouse and Dam.
    - West Boat Launch – Used to launch and take out smaller boats.
    - ELC Canoe and Kayak Dock.
    - Dry Dock and Marine Rail System – Used to take boats out of the water for storage and maintenance.
- South shoreline at the east end of the reservoir near Ross Powerhouse:
    - Ross Powerhouse Boathouse and Dock – Provides covered storage and docking space for crew boats and a dock for the tour boat.
    - East Barge Landing – Terminus/return of materials and equipment arriving by barge.
    - East Boat Ramp – Used to get smaller boats on and off Diablo Lake and to/from Ross Lake.

- East Ferry Landing – Loading/unloading dock for visitors travelling to and from Ross Lake. Visitors can walk to/from the reservoir or be transported via a shuttle run by Ross Lake Resort, which is privately-owned and operated under a NPS Special Use Permit. The resort provides the only lodging on Ross Lake.
- Lake Kayak/Canoe Dock – Next to the Ferry Dock; used mostly by visitors needing to shuttle non-motorized craft to Ross Lake.
- East Dock – Built by City Light for NPS to temporarily moor small boats used to patrol Diablo Lake.

Other marine facilities on Diablo Lake are operated and maintained by NPS; these include a boat ramp and dock at Colonial Creek Campground and a nearby boathouse.

Access to Ross and Gorge lakes is not routinely needed by City Light staff and is generally limited to crews managing wood on these lakes or engaged in scientific data collection. On Gorge Lake there is a paved boat ramp and dock in Gorge Campground that is primarily used by the public. There is also a primitive boat ramp in the Reflector Bar section of Diablo that is used by City Light only if the water level in Gorge Lake is too low to use the launch at the campground.

On the southern end of Ross Lake, City Light built and maintains a boathouse on the face of the dam that floats up and down with reservoir elevation (Figure 3.4-18). This facility is accessed via a locked gate and stairs from the top of Ross Dam. The boathouse, which is shared with NPS and U.S. Customs and Border Patrol, has two covered docks/slips and an external dock on each side. There is a boat launch and dock on the east side of Ross Lake just upstream of Ross Dam. Use of this boat launch and dock is shared by City Light, NPS, and Ross Lake Resort. The only fueling dock on the reservoir is at Ross Lake Resort. City Light purchases fuel for its boats used on Ross Lake at this facility. NPS has a boat ramp and dock at the northern end of Ross Lake which is used by City Light when needed.

Figure 3.4-18. Ross Lake boathouse.

3.4.7 Recreation and Visitor Service Facilities

Because of its location in RLNRA, most of the recreation facilities within the Project Boundary are managed by NPS, not City Light. These include multiple campgrounds and trailheads along Diablo and Ross lakes. The current Project license provided capital funding for NPS to construct and upgrade a variety of recreational facilities in RLNRA. Funding was also provided to USFS to develop and improve multiple recreational sites within the Skagit River Wild and Scenic River System and along SR 20. The major capital projects identified in and subsequent to the license have been or will be completed during the current Project license term. City Light continues to provide funds for recreational programs and site maintenance to both agencies as per the terms of the current Project license. The recreational facilities and activities identified in the license, as specific City Light responsibilities, are focused on interpretation and education. City Light recreational sites and facilities are displayed in Figure 3.4-19 and described briefly below, with more detail provided in Section 4.8.

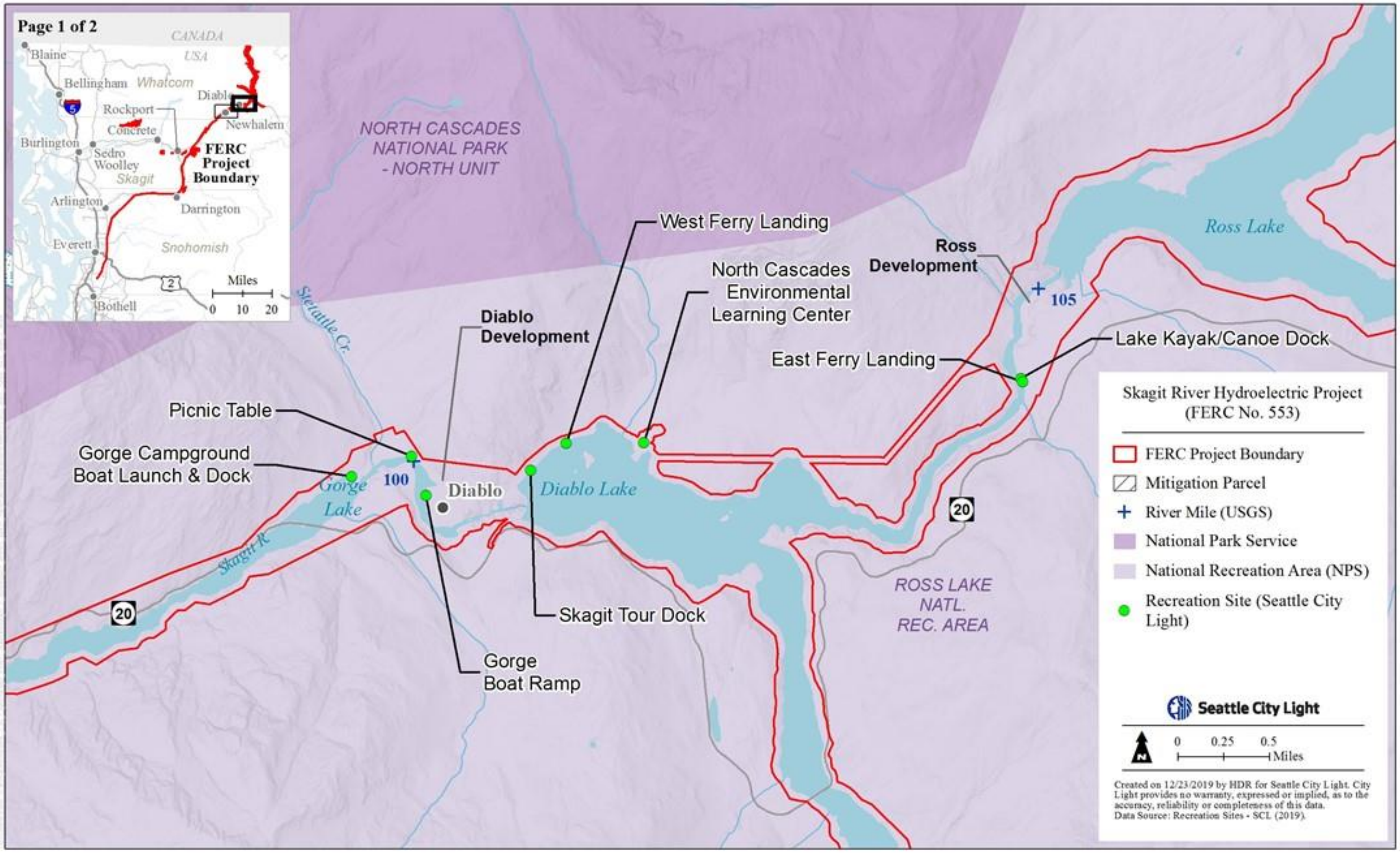

Figure 3.4-19. City Light recreation facilities of the Skagit River Project (page 1 of 2).

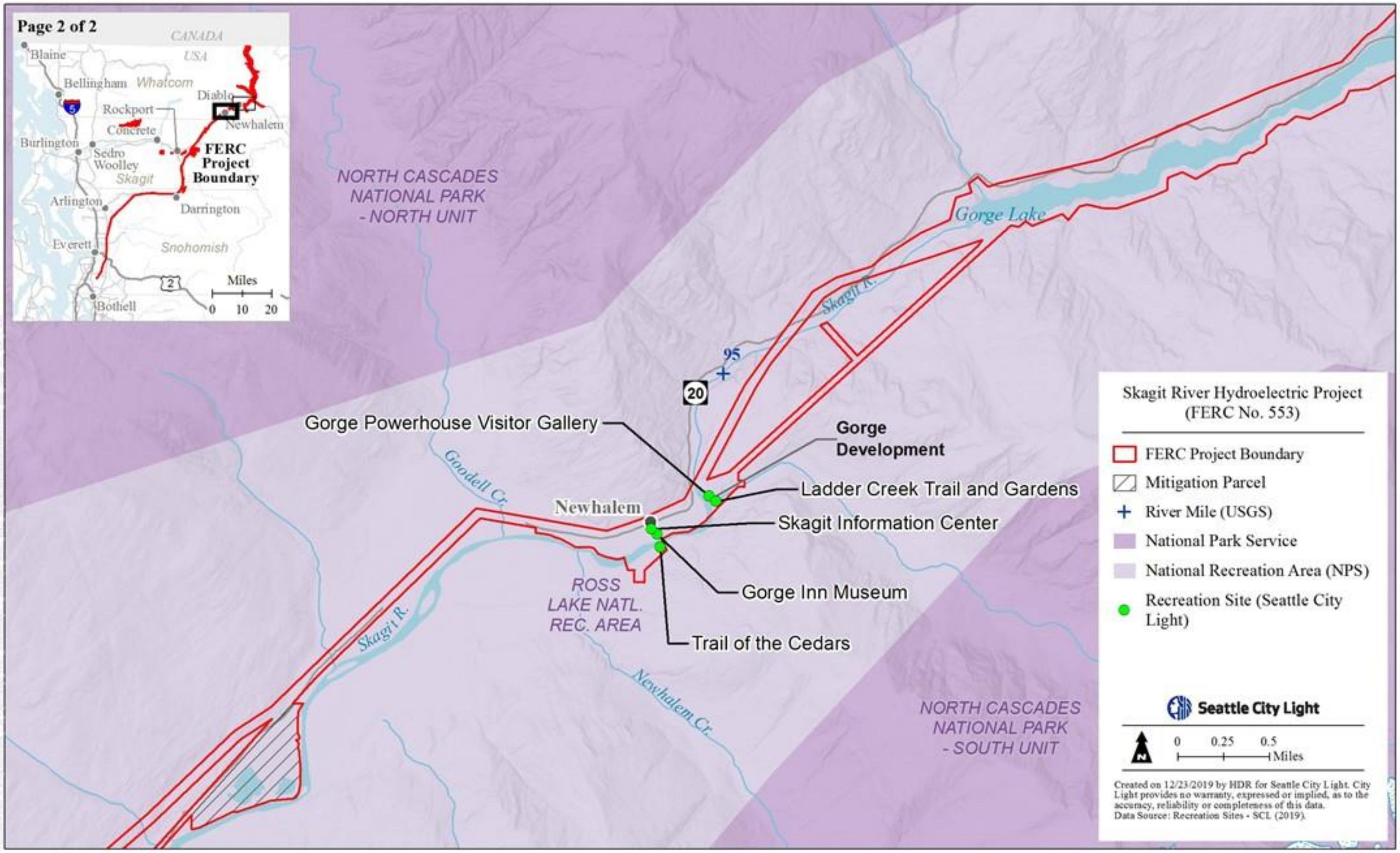

Figure 3.4-19. City Light recreation facilities of the Skagit River Project (page 2 of 2).

North Cascades Environmental Learning Center – The ELC is located on the north shore of Diablo Lake and was built and is owned by City Light (Figure 3.4-20). It is in the Project Boundary on land managed by NPS and is operated for City Light by NCI under a lease agreement. The facility has 16 buildings including classrooms, a library, labs, overnight lodging and housing for graduate students and staff, a lakeside dining hall, and a recycling and composting center. The campus also features an outdoor amphitheater, outdoor learning shelters, a dock on Diablo Lake, and various trails and paths (see Section 4.8 for additional detail).

Figure 3.4-20. North Cascades Environmental Learning Center.

Gorge Inn Museum – Gorge Inn, constructed in 1920, is the oldest building remaining at the Project. Located in Newhalem, it was the cookhouse for construction workers and visitors until sometime in the 1970s when it was closed due to the need for major repairs. It was completely renovated in 2010 and again serves as a dining hall for Skagit staff and visitors. A small museum was installed in the front of the building.

Gorge Powerhouse Visitor Gallery – The visitor gallery was added to Gorge Powerhouse in 1949 when this structure was expanded (Figure 3.4-21). The gallery is located above the powerhouse floor and provides a view of the generators and other equipment below as well as photographs and exhibits about the Skagit River Project.

Figure 3.4-21. Exhibits in Gorge Powerhouse Visitor Gallery.

Ladder Creek Trail and Garden – The trail to Ladder Creek Falls (Figure 3.4-22), a dramatic series of waterfalls in a slot canyon, starts next to Gorge Powerhouse and winds up the creek and through a garden developed on the adjacent hillside. The trail includes interpretive signs and the falls are illuminated at night with colored lights. While it is completely on NPS land, it is in the Project Boundary and is maintained by City Light.

Figure 3.4-22. Ladder Creek Falls.

Trail of the Cedars – This interpretive trail provides pedestrian access from Newhalem to the Newhalem Creek Powerhouse and links with a NPS trail that leads to Newhalem Campground. Constructed and maintained by City Light, the trail begins at the suspension bridge at the end of Main Street in Newhalem, crosses the river, and then loops through the forest and along the river. It is within the Project Boundary on NPS land.

Skagit Information Center – The Skagit Information Center, which is located just off SR 20 on Main Street in Newhalem (Figure 3.4-23), includes restrooms, a breezeway with cases for maps and the Project Part 8 signs, and a large room with interpretive exhibits.

Figure 3.4-23. Skagit Information Center in Newhalem.

Other Newhalem Recreation/Visitor Facilities – Newhalem has several other public recreation and visitor service facilities. These include Americans with Disabilities Act (ADA)-compliant parking facilities, a playground, picnic tables, numerous interpretive signs, and additional restrooms (Figure 3.4-24). There are also two public art installations on display in Newhalem – the Tower of Power and a bronze sculpture of fish native to the Skagit River. The City Light-run Skagit General Store, located on Main Street, is also open to the public and provides a variety of packaged and prepared food items and beverages, camping supplies, ice, and firewood.

Figure 3.4-24. Interpretive sign near Gorge Switchyard.

Diablo Recreation/Visitor Facilities – The only City Light recreation/visitor services in the town of Diablo are a picnic shelter, parking for the Sourdough and Stetattle Creek trailheads, and a primitive boat launch. NPS operates and maintains Gorge Campground just outside Diablo. An associated boat launch and dock are maintained by City Light on City Light property. City Light uses and maintains the launch and dock which is also used by the public.

City Light provides boat tours of Diablo Lake in the summer and runs a ferry service across the lake. The facilities needed to support these activities include a tour dock and two ferry landings (see Section 3.4.6.3 of this PAD for detail).

Marblemount and Sauk River Boat Launches – The Marblemount and Sauk River boat launches are distant from the generating facilities and City Light-owned towns but were brought into the Project Boundary as required by the current Project license. Both were constructed with Skagit license funds by USFS, are on USFS-managed land within the Skagit River Wild and Scenic River System and are maintained by USFS. The Marblemount Boat Launch is on the Skagit River (around RM 77), just upstream of the confluence with the Cascade River and about 12 miles downstream from Newhalem. The Sauk River Boat Launch is about 35 miles from Newhalem, just off SR 530 near the confluence of the Sauk and Suiattle rivers.

Both the Marblemount and Sauk River boat launches are open to the public and include parking, restrooms, and information kiosks. The Sauk River Boat Launch also has a picnic shelter. Neither boat launch is paved. City Light routinely uses the Marblemount Boat Launch to conduct fish spawning surveys in the Skagit River. Marblemount Boat Launch is also heavily used by fishers and recreational boaters.

3.4.8 Other Facilities

City Light owns and maintains a few other auxiliary facilities, including:

- A trailer/bunkhouse and storage building at Hozomeen Camp on the northern end of Ross Lake;
- A primitive boat ramp on the Skagit River and a storage yard for aggregate materials, including wood, rock, and soil near Newhalem Ponds (Agg Ponds), just south of Newhalem;
- The Happy Creek Diversion, which diverts Happy Creek into Ross Lake from its original outfall downstream of Ross Powerhouse;
- The Babcock Communications Site, which includes a shelter and 120-foot-tall communications tower on Babcock ridge. City Light facilities at this site include: a portion of a microwave link to Seattle (Newhalem-Babcock-Segelsen-Eagle Ridge-Bothell); a repeater site for an 800 MHz radio system; and a remote base site for a 37 MHz radio system. Other, non-Project facilities at this site include: Whatcom County Sheriff's Office UHF repeater; Skagit County Fire and HEAR VHF remote base; WSDOT 700/800 MHz repeaters; Verizon Wireless cell equipment (shelter and stand-by generator); and AT&T mobility cell equipment (located on the roof of City Light's shelter). Both cell carriers have panel and microwave antennas mounted on City Light's tower. A fiber optic cable from the Babcock Communication Tower to Newhalem is mounted on the distribution lines that provide power to the site;
- Various other fiber optic cables mounted on transmission line towers and/or distribution poles between Newhalem and Bothell; Newhalem and Diablo; Diablo and Ross; and Ross and the ELC; and
- Stream gages to measure inflows to Ross Lake and Diablo Lake and flows in the Skagit River downstream of the Project. Under an agreement with City Light, USGS installed and maintains five gages in the U.S. The gages for Ross Lake are on Big Beaver and Ruby creeks; the Diablo gage is on Thunder Creek. The downstream gages are at Newhalem, near the bridge to Trail of the Cedars, and at Marblemount, just upstream of the confluence with the Cascade River. A sixth gage was recently installed on the Skagit River several miles from Ross Lake in British Columbia. It is maintained by Environment and Climate Change Canada under an agreement with City Light.

3.4.9 Off-channel Fish Habitat Sites

Under Article 401 of the current Project license, City Light developed and maintains six sites to provide off-channel spawning and rearing habitat for Chum Salmon (Figure 3.4-25). These include:

- Newhalem Ponds (Agg Ponds) and County Line Ponds – Originally formed in two areas along the river south of Newhalem that were used to mine gravel for Project construction. City Light ensures that the connections between the ponds and the river are maintained at both sites.
- Park Slough – Originally developed by the Department of Fisheries on land managed by NPS, City Light took over maintenance of the site beginning in 1995.
- Taylor Spawning Channel – Developed on USFS property upstream of the town of Marblemount (Figure 3.4-26).
- Powerline Spawning Channel – Developed within the transmission line corridor on the City Light's Illabot North wildlife mitigation parcel.
- Illabot Spawning Channel – Developed on City Light's Illabot North wildlife mitigation parcel about one-quarter mile downstream of Powerline Channel Boundary (Figure 3.4-27).

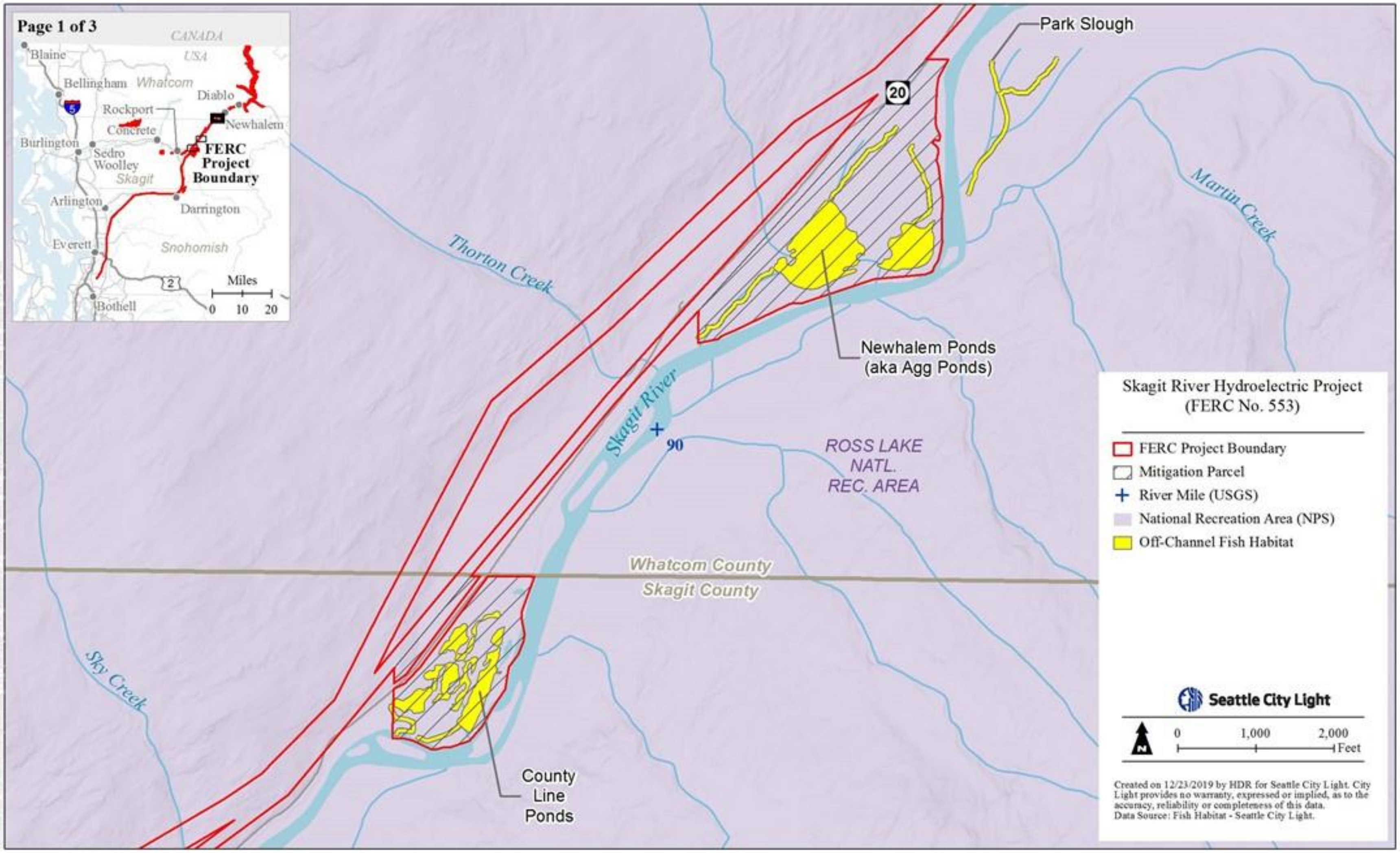

Figure 3.4-25. Off-site fish habitat sites of the Skagit River Project (page 1 of 3).

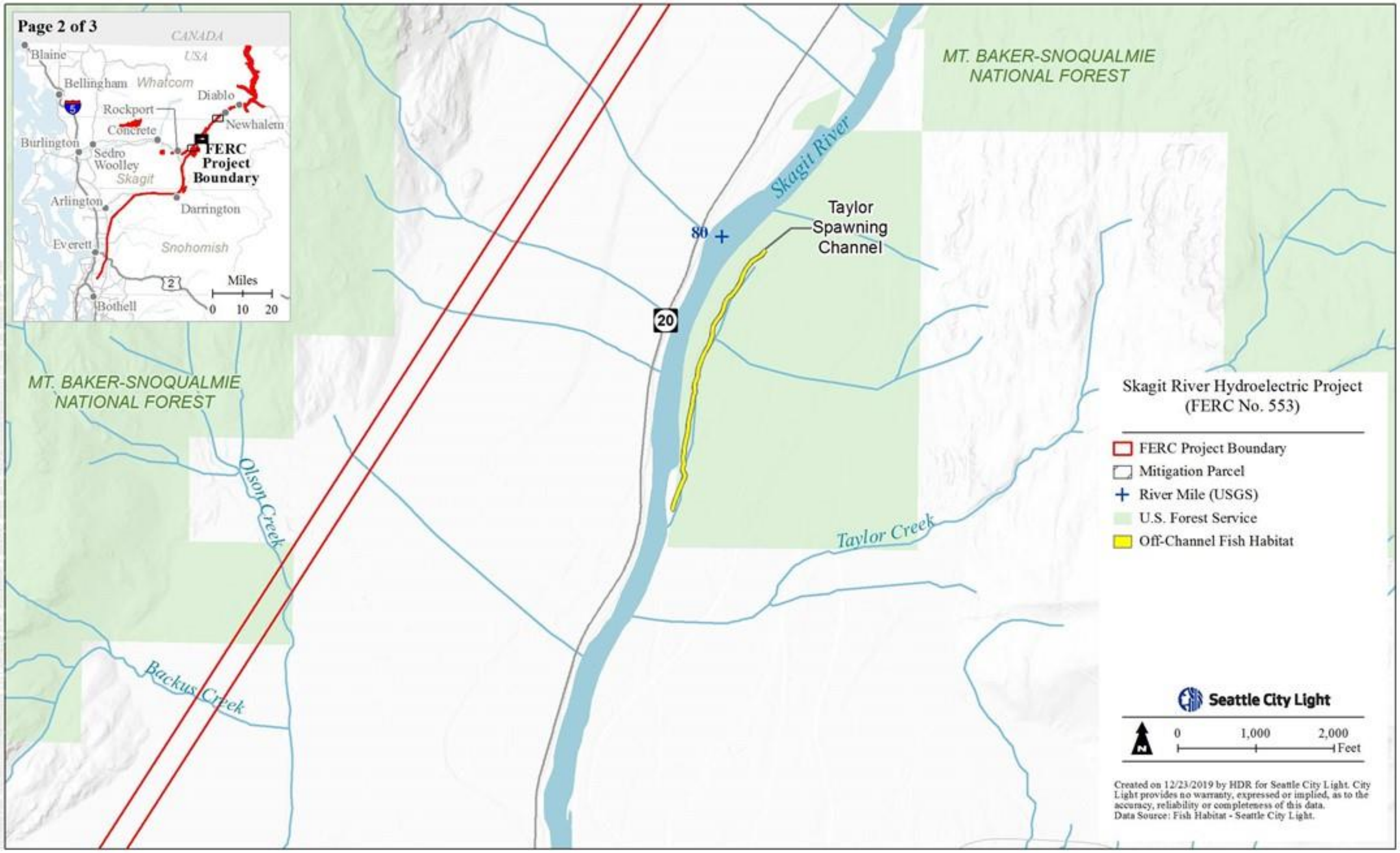

Figure 3.4-25. Off-site fish habitat sites of the Skagit River Project (page 2 of 3).

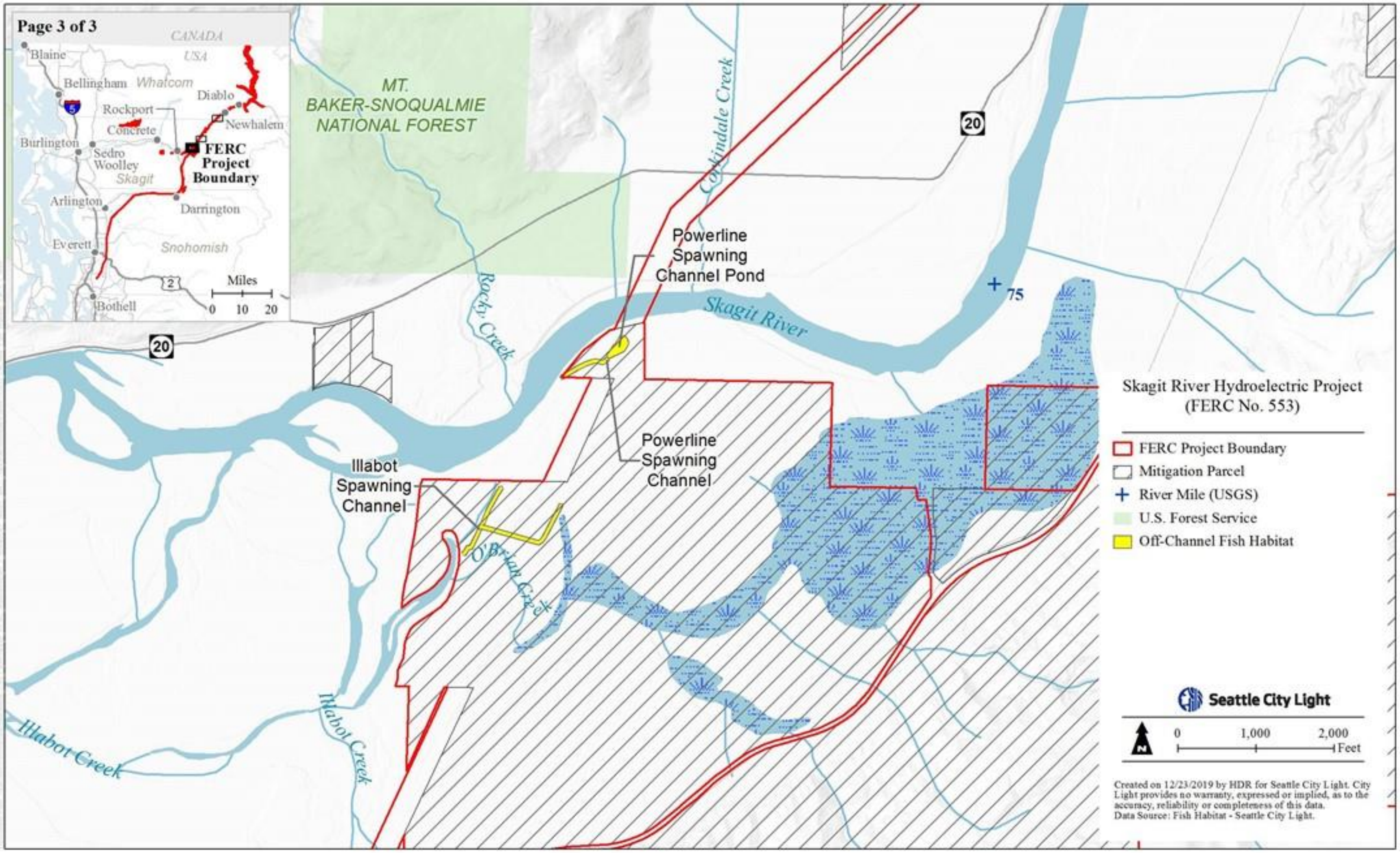

Figure 3.4-25. Off-site fish habitat sites of the Skagit River Project (page 3 of 3).

Figure 3.4-26. Taylor Spawning Channel.

Figure 3.4-27. Illabot Spawning Channel.

3.4.10 Fish and Wildlife Mitigation Lands

Under the current Project license, City Light dedicated $17 million (1990 dollars) for the acquisition and management of wildlife habitat in and near the Skagit River basin. As of the end of 2019, over $16.8 million (1990 dollars) have been spent purchasing and managing wildlife habitat in 19 management areas totaling approximately 10,450 acres (Figures 3.4-28 and 3.4-29). These areas include 3.5 miles of Skagit and Sauk river shorelines, 8.7 miles of the South Fork Nooksack River, and about 97 miles of tributary streams in these three watersheds. The largest habitat management unit, which is along the South Fork Nooksack River, is 4,420 acres, and was acquired in a series of transactions between 1991 and 2013. The second largest block is the 3,247-acre area made up of the Illabot South and Illabot North Management Units, the latter of which encompasses 1.7 miles of Illabot Creek. The remaining management units are smaller, and most are bordered by other lands protected by federal and state agencies and private land trusts.

Under the terms of the Wildlife Settlement Agreement (WSA), all land purchases must be unanimously approved by the Land Acquisition Group (LAG), which was established by the current Project license and includes representatives from NPS, USFS, USFWS, Washington Department of Fish and Wildlife (WDFW), Swinomish Indian Tribal Community, Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and North Cascades Conservation Council (NCCC). All the Skagit River Project wildlife mitigation lands owned by City Light as of 2011 were brought into the Project Boundary, as directed by the Project license, as part of an amendment process. Since 2011, an additional approximately 1,350 acres have been acquired. On January 27, 2020, FERC approved the acquisition and disposition of lands pursuant to Articles 408 and 410 to include all aforementioned lands acquired since 2011 within the Project Boundary. FERC ordered City Light to revise Exhibit K to reflect these changes within 60-days of this order. This PAD and figures illustrating the location of fish and wildlife mitigation lands were prepared prior to receiving this order, however all figures and resource descriptions remain accurate with respect to the lands depicted; subsequent license documents will reflect the revised Project Boundary annotation to incorporate all fish and wildlife mitigation lands.

Lands acquired prior to 2006 are managed according to a management plan that was developed and approved by the Wildlife Management Review Committee (WMRC), which consists of LAG members except that NCCC is a non-voting member. Lands acquired since then are managed through annual coordination with the WMRC.

In addition to wildlife lands, the Fisheries Settlement Agreement (FSA) included funds to acquire and manage high quality fish habitat. To date, City Light has restored and is managing lands around Newhalem Ponds and County Line Ponds to provide functional off-channel habitat for fish. In addition, City Light purchased four parcels using this funding. Combined, City Light-owned lands managed as fish habitat total approximately 400 acres. Some of these lands were added to the Project Boundary in 2011 (Johnson, County Line Ponds, and Newhalem Ponds), and those acquired since (Bogert and Tam, Day Creek Slough, and Savage Slough [combination wildlife and fish]), are depicted in this PAD as located outside of the Project Boundary. Per FERC's January 27, 2020 order, subsequent license documents will reflect the revised Project Boundary.

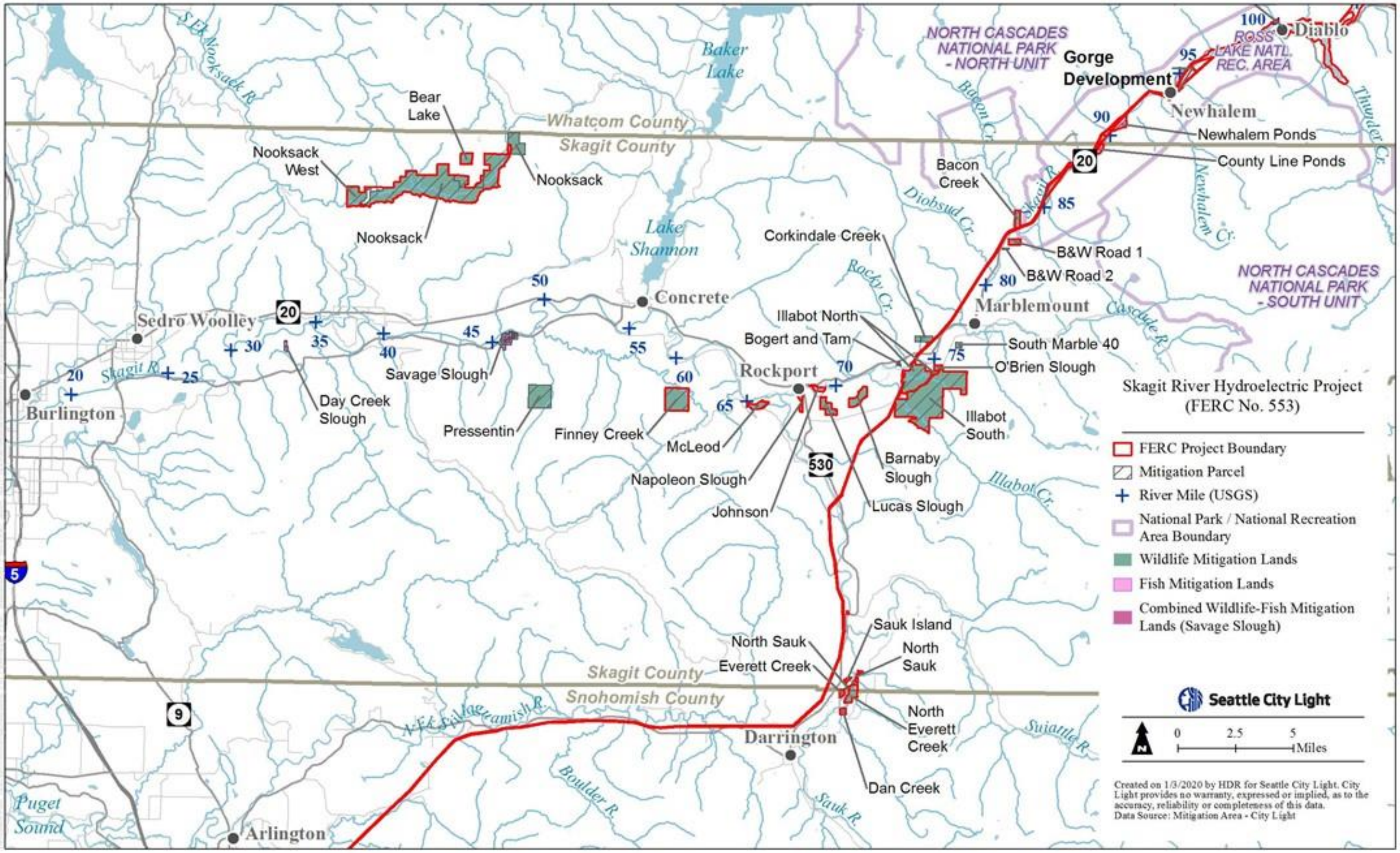

Figure 3.4-28. Fish and wildlife mitigation lands of the Skagit River Project.

Figure 3.4-29. Barnaby Slough wildlife property.

3.4.11 Project Lands

The Skagit River Project Boundary consists of 31,451 acres and encompasses all Project facilities, including the dams, powerhouses, reservoirs, power tunnels, switchyards, transmission lines, and the towns of Newhalem and Diablo, as well as most of the fish and wildlife lands and several recreation sites (see Sections 3.4.7 to 3.4.10 of this PAD; current Project Boundary maps [Exhibit Ks] dated June 2011). It terminates in Washington State, at the U.S.-Canada border. The Project Boundary along Diablo and Gorge lakes extends about 200 feet (horizontal measurement) beyond the normal maximum water surface elevation. For Ross Lake, the Project Boundary was established to accommodate High Ross. As a result, the Project Boundary around Ross Lake reaches significantly up several of the major tributaries, including Big Beaver, Little Beaver, Lightning, and Ruby creeks. While in the Project Boundary, lands associated with the inundation zone of High Ross are not impacted by current operations and therefore anticipated generally to be excluded from geographic scope of relicensing studies. The land within the Project Boundary around the generating facilities is entirely in federal and City Light ownership.

The Project Boundary does not include the bypass reach between Gorge Dam and Powerhouse or the Skagit River downstream of Gorge Powerhouse except for areas that overlap the transmission lines and Trail of the Cedars. The width of the Project Boundary along the transmission lines ranges from about 300 to 400 feet when the two lines share the same ROW and from 150 to 200 feet when the lines separate. There are some guy wires and transmission line ROW access trails and roads that may be outside the Project Boundary or only partially included. Lands within the Project Boundary include a mix of federal, state, county, and private lands, with most of the federal lands located north of Marblemount (Figure 4.3-30).

Most of the City Light-owned fish and wildlife mitigation lands, as well as the Marblemount and Sauk River boat launches, are non-continuous features within the Project Boundary and are mapped as "islands."

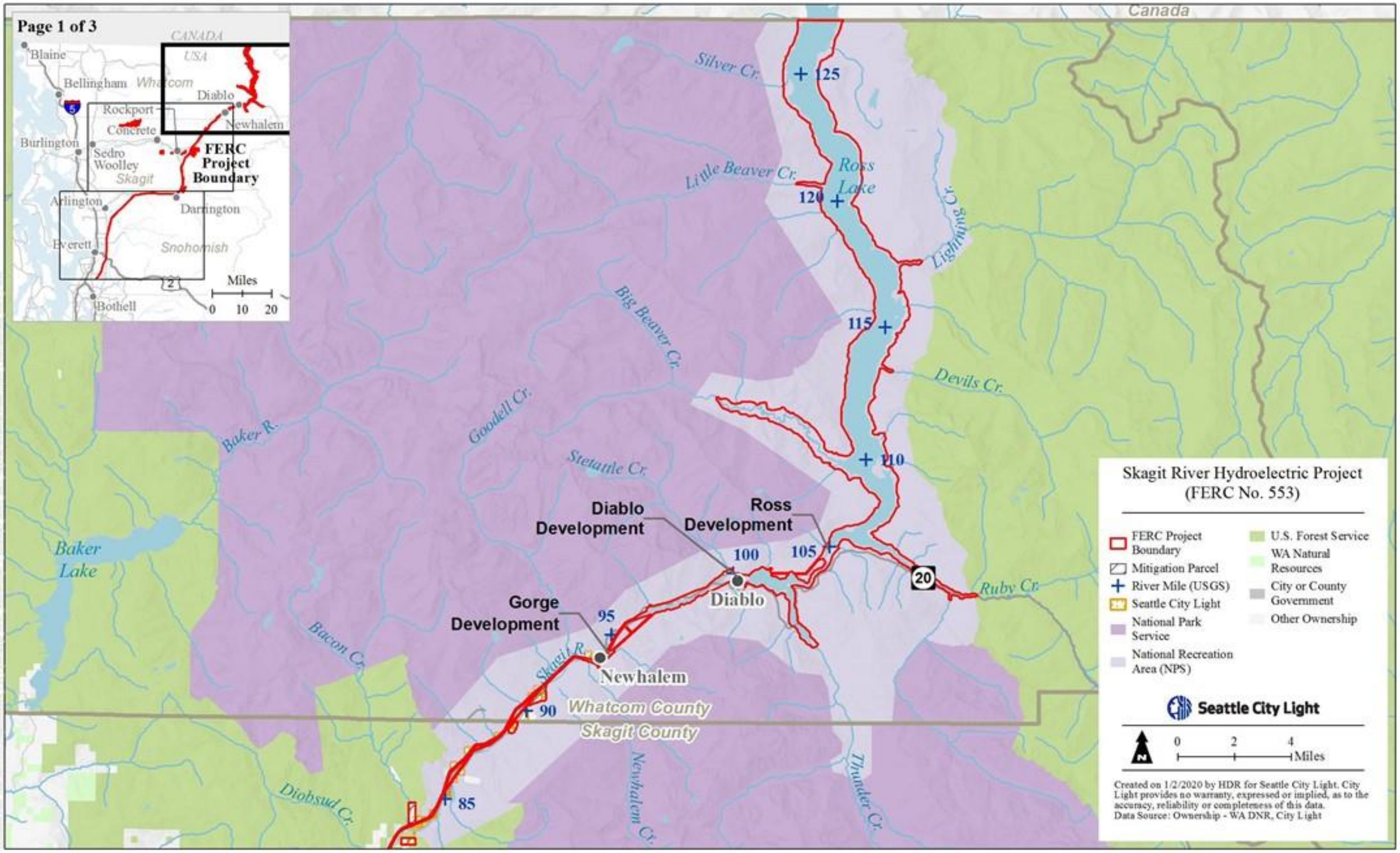

Figure 3.4-30. Skagit River Project vicinity land ownership (page 1 of 3).

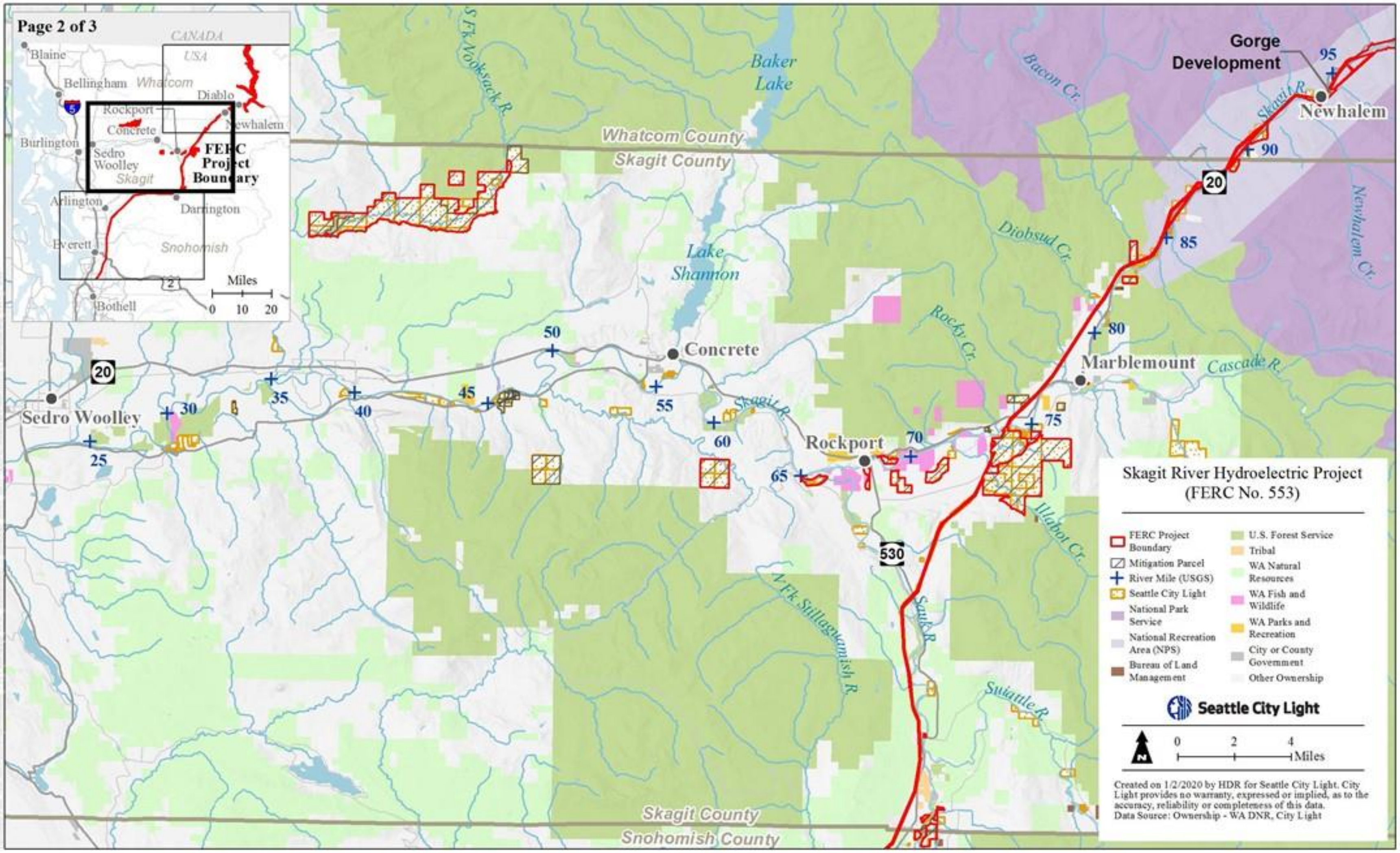

Figure 3.4-30. Skagit River Project vicinity land ownership (page 2 of 3).

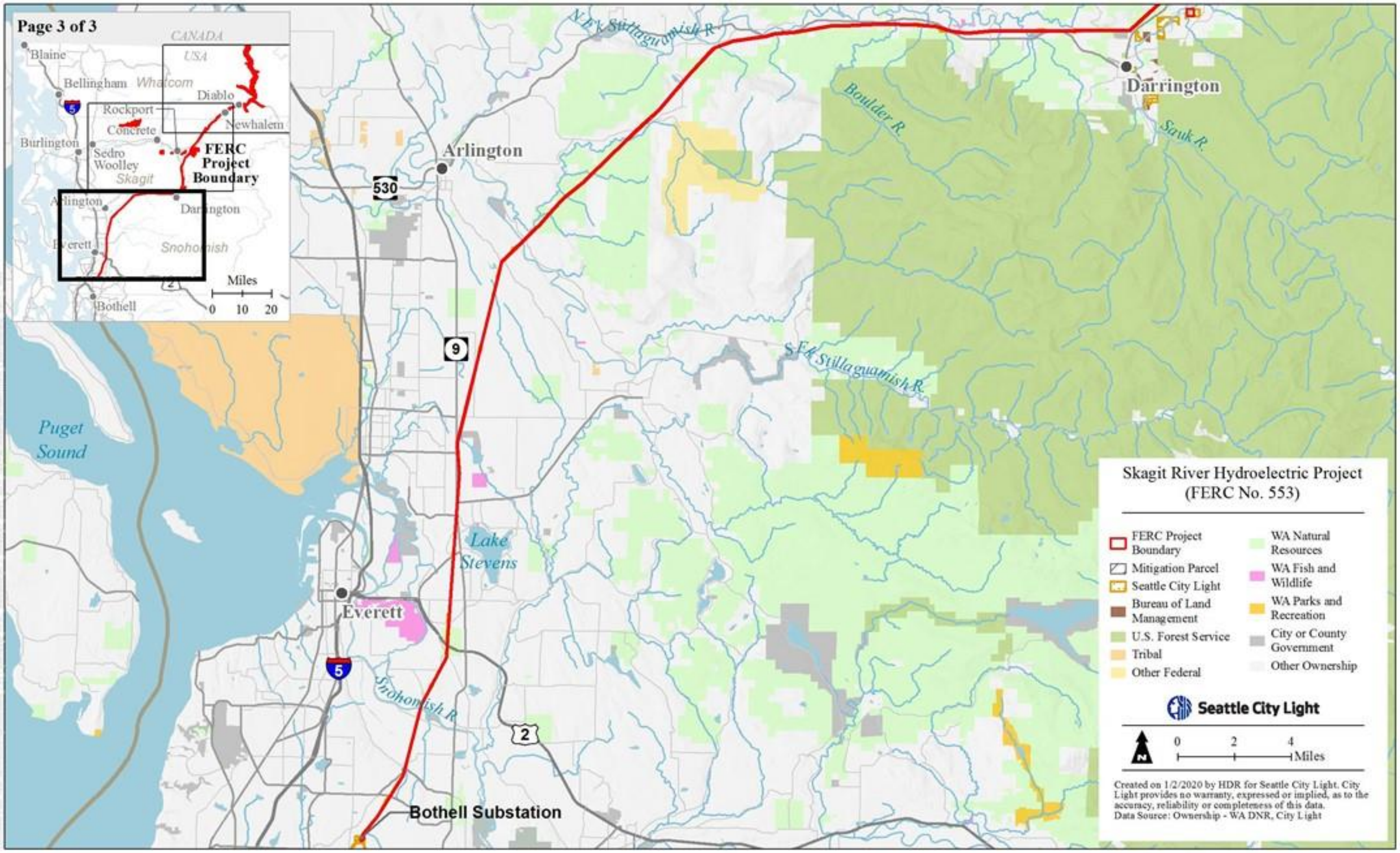

Figure 3.4-30. Skagit River Project vicinity land ownership (page 3 of 3).

3.5 Project Operations

The three Skagit River developments are hydraulically coordinated to operate as a single project to control flooding, provide flows in the river downstream of the Project that are protective of salmon and steelhead reproduction and rearing, provide recreation at Ross Lake, and supply power. Operations at each of the Skagit developments are described below.

3.5.1 Reservoir Operations

While the primary purpose of all three Project reservoirs is to provide water for generation, each one has other purposes and is operated differently. Article 302 of the current Project license requires that City Light comply with requests for operational changes from the U.S. Army Corps of Engineers (USACE) during flood conditions. In addition, operations at each reservoir involve managing woody debris that enters the system from the shorelines or tributaries.

3.5.1.1 Ross Development

Ross Lake is the primary storage for the Project and is drawn down in the winter to capture water from spring runoff and to provide for downstream flood control. City Light typically begins drawing down the reservoir shortly after Labor Day. Storage capacity at a normal maximum water surface elevation of 1,602.5 feet is 1,435,000 acre-feet; usable storage in 1,052,000 acre-feet—which is 68 times the combined usable storage of the other two reservoirs. If needed, the reservoir can be surcharged by 2.5 feet to the top of the spill gates to absorb an additional 95,000 acre-feet.

Monthly minimum, average, and maximum water surface elevations at Ross Lake for the period 1991–2018 are provided in Table 3.5-1. The lowest licensed water surface elevation is 1,474.5 feet, 127 feet below the normal maximum (Figure 3.5-1). This level was exceeded only once in the current license period, in April 1999, in anticipation of run-off from a very large snowpack; the second lowest water surface elevation, 1,477.7 feet, occurred that same year in May. Between 2009 and 2018, the average low water surface elevation was 1,535 feet. Winter reservoir levels below elevation 1,592 feet are managed for generation based on forecasted precipitation (Figure 3.5-2). In advance of a predicted flood event, generation at Ross is increased to the maximum generation to provide additional usable storage in the reservoir. Ross Lake can fill quickly, up to a foot a day during spring runoff and more during warm rain-on-snow events.

In addition to forecasted precipitation, City Light also uses snowpack data to manage winter drawdown levels in Ross Lake. Snow surveys are conducted monthly from December 1 through April 1 by an independent contractor using a helicopter to access 16 snow course stations on the ridges of the watershed. The data on snow depth and water content are used to predict the amount of spring run-off, which is then used to determine the lowest drawdown level, which is typically reached in late March or early April.

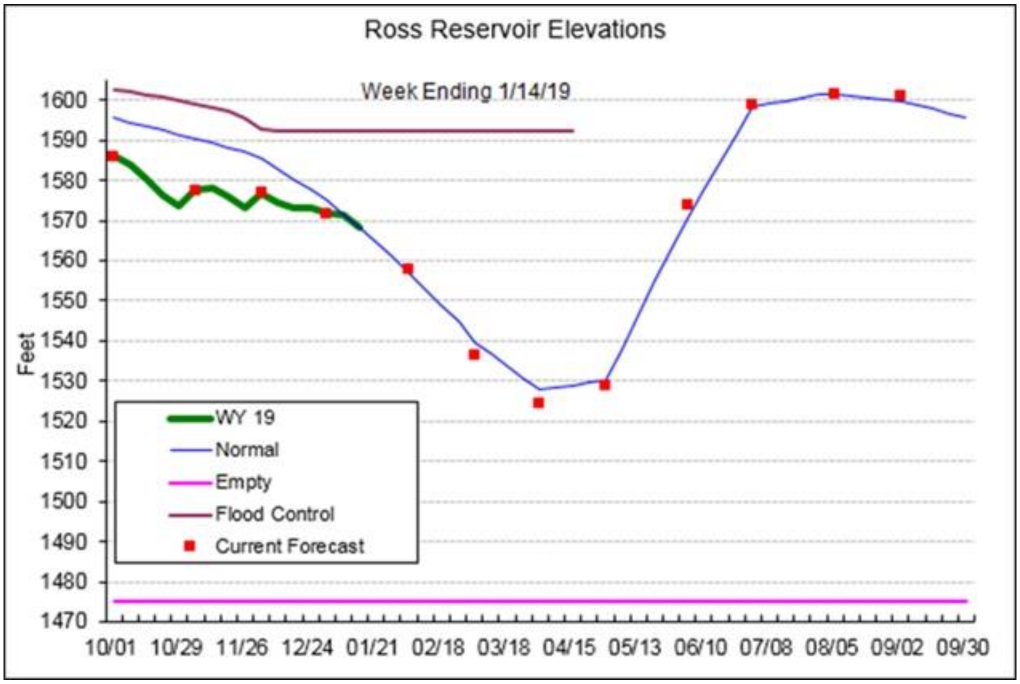

Figure 3.5-1. Ross Lake actual and projected elevation, 2019 water year.

Figure 3.5-2. Ross Lake under winter drawdown conditions.

Table 3.5-1. Monthly and annual maximum, average, and minimum water surface elevations (feet) at Ross Dam.

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1991	Max	1,587.1	1,569.5	1,547.4	1,518.5	1,546.9	1,591.7	1,602.5	1,602.4	1,601.8	1,596.6	1,588.4	1,585.6	1,602.5
	Ave	1,578.2	1,560.5	1,534.5	1,516.0	1,527.8	1,567.4	1,599.9	1,602.2	1,599.2	1,592.4	1,587.3	1,583.4	1,570.8
	Min	1,567.2	1,548.1	1,518.6	1,512.9	1,514.3	1,548.1	1,593.1	1,601.9	1,596.8	1,588.4	1,585.6	1,578.3	1,512.9
1992	Max	1,577.7	1,564.6	1,544.8	1,543.7	1,576.3	1,596.7	1,597.9	1,593.6	1,588.3	1,587.1	1,580.0	1,566.2	1,597.9
	Ave	1,567.9	1,555.8	1,537.4	1,534.6	1,562.2	1,586.7	1,596.2	1,591.4	1,587.2	1,584.3	1,573.1	1,558.5	1,569.7
	Min	1,560.9	1,545.2	1,533.5	1,531.9	1,545.2	1,577.2	1,593.3	1,588.5	1,586.2	1,580.3	1,566.6	1,552.0	1,531.9
1993	Max	1,551.3	1,532.8	1,516.1	1,519.5	1,576.8	1,599.5	1,602.3	1,602.4	1,601.7	1,596.4	1,590.7	1,575.4	1,602.4
	Ave	1,541.2	1,525.0	1,513.8	1,517.0	1,547.1	1,591.2	1,601.0	1,602.2	1,599.5	1,593.4	1,583.0	1,572.2	1,565.8
	Min	1,533.2	1,515.8	1,512.0	1,515.9	1,520.1	1,578.2	1,599.6	1,601.8	1,596.6	1,591.0	1,575.7	1,567.3	1,512.0
1994	Max	1,567.1	1,553.0	1,539.9	1,549.9	1,579.8	1,595.2	1,600.4	1,599.7	1,594.4	1,586.1	1,579.4	1,570.1	1,600.4
	Ave	1,561.0	1,544.2	1,538.7	1,541.6	1,566.6	1,587.7	1,598.8	1,597.8	1,590.4	1,581.8	1,574.2	1,566.5	1,571.0
	Min	1,553.3	1,536.7	1,537.1	1,537.7	1,550.7	1,580.3	1,595.7	1,594.6	1,586.3	1,579.5	1,569.0	1,563.5	1,536.7
1995	Max	1,566.4	1,544.8	1,540.6	1,517.7	1,554.0	1,588.4	1,602.2	1,602.5	1,599.3	1,595.7	1,602.3	1,601.6	1,602.5
	Ave	1,554.2	1,541.9	1,529.3	1,512.0	1,526.1	1,574.1	1,597.8	1,601.3	1,597.2	1,594.8	1,596.1	1,591.6	1,568.2
	Min	1,542.6	1,537.9	1,518.4	1,507.8	1,508.1	1,556.3	1,589.5	1,599.6	1,595.1	1,593.7	1,592.0	1,587.3	1,507.8
1996	Max	1,589.8	1,579.7	1,575.1	1,561.5	1,565.1	1,590.9	1,602.0	1,601.9	1,601.3	1,595.1	1,590.1	1,584.7	1,602.0
	Ave	1,587.2	1,577.1	1,568.1	1,559.0	1,560.0	1,581.0	1,599.4	1,601.5	1,599.0	1,592.7	1,587.5	1,579.6	1,582.7
	Min	1,580.4	1,575.5	1,559.7	1,555.5	1,556.7	1,565.4	1,591.5	1,600.9	1,595.5	1,590.2	1,584.7	1,573.0	1,555.5
1997	Max	1,574.5	1,563.3	1,543.9	1,531.8	1,577.0	1,602.1	1,602.3	1,602.3	1,601.8	1,602.3	1,599.3	1,587.8	1,602.3
	Ave	1,568.7	1,555.3	1,533.7	1,526.6	1,548.0	1,596.8	1,602.0	1,602.0	1,601.0	1,599.8	1,593.5	1,582.4	1,575.9
	Min	1,561.8	1,544.9	1,525.4	1,522.4	1,526.6	1,580.7	1,601.8	1,601.6	1,600.3	1,597.8	1,588.0	1,577.5	1,522.4
1998	Max	1,577.4	1,560.1	1,545.4	1,526.9	1,570.0	1,597.3	1,602.3	1,602.2	1,597.5	1,588.9	1,577.5	1,572.8	1,602.3
	Ave	1,568.8	1,553.5	1,534.6	1,519.0	1,552.0	1,587.3	1,601.4	1,600.9	1,593.3	1,583.5	1,574.1	1,570.6	1,570.1
	Min	1,560.5	1,546.0	1,527.8	1,513.5	1,521.2	1,571.4	1,597.8	1,597.8	1,589.3	1,577.8	1,572.8	1,568.2	1,513.5
1999	Max	1,570.9	1,553.0	1,523.0	1,489.1	1,512.8	1,576.8	1,602.2	1,602.3	1,601.1	1,594.1	1,599.1	1,591.0	1,602.3
	Ave	1,563.6	1,539.0	1,504.6	1,475.6	1,485.5	1,544.6	1,594.6	1,601.2	1,598.0	1,590.8	1,591.8	1,590.1	1,556.8
	Min	1,553.9	1,524.1	1,490.0	1,467.1	1,477.7	1,515.0	1,578.4	1,599.8	1,594.5	1,587.4	1,586.7	1,588.5	1,467.1

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2000	Max	1,588.2	1,563.2	1,538.1	1,529.6	1,559.2	1,598.1	1,602.3	1,602.4	1,599.3	1,593.3	1,586.5	1,572.3	1,602.4
	Ave	1,577.3	1,551.3	1,527.0	1,521.9	1,541.6	1,580.6	1,600.7	1,601.3	1,596.2	1,589.9	1,580.1	1,564.3	1,569.4
	Min	1,563.9	1,539.0	1,51,6.7	1,51,5.8	1,530.2	1,560.2	1,598.4	1,599.6	1,592.9	1,586.8	1,572.6	1,557.7	1,515.8
2001	Max	1,557.3	1,548.1	1,538.2	1,532.6	1,564.5	1,585.2	1,590.8	1,589.7	1,584.7	1,577.8	1,579.6	1,578.9	1,590.8
	Ave	1,553.9	1,543.8	1,533.7	1,529.3	1,545.5	1,576.1	1,589.6	1,587.2	1,581.2	1,574.0	1,574.7	1,576.4	1,563.9
	Min	1,548.5	1,538.7	1,530.9	1,527.6	1,533.2	1,565.6	1,585.8	1,584.8	1,578.2	1,571.2	1,570.1	1,574.8	1,527.6
2002	Max	1,578.9	1,563.3	1,544.3	1,517.7	1,541.4	1,598.8	1,602.0	1,601.9	1,600.8	1,596.8	1,589.3	1,582.8	1,602.0
	Ave	1,573.4	1,552.0	1,528.0	1,512.4	1,521.3	1,573.6	1,601.0	1,601.4	1,598.8	1,593.9	1,585.6	1,580.0	1,568.6
	Min	1,564.3	1,545.0	1,511.9	1,504.9	1,51,5.2	1,543.8	1,598.8	1,600.8	1,596.9	1,589.7	1,583.1	1,578.1	1,504.9
2003	Max	1,578.1	1,570.7	1,559.2	1,561.6	1,579.1	1,601.2	1,602.4	1,602.3	1,597.7	1,601.3	1,597.7	1,587.7	1,602.4
	Ave	1,571.3	1,566.0	1,556.5	1,560.9	1,565.9	1,594.1	1,601.9	1,600.2	1,594.1	1,592.2	1,593.7	1,584.6	1,581.9
	Min	1,564.3	1,558.4	1,552.3	1,559.8	1,561.3	1,580.6	1,600.9	1,597.8	1,589.9	1,586.0	1,588.2	1,580.0	1,552.3
2004	Max	1,579.7	1,557.6	1,528.6	1,548.2	1,585.4	1,602.2	1,602.1	1,602.0	1,600.7	1,598.4	1,589.1	1,587.8	1,602.2
	Ave	1,568.6	1,542.6	1,525.8	1,538.0	1,568.4	1,597.3	1,602.0	1,600.8	1,599.8	1,594.6	1,583.4	1,584.7	1,575.6
	Min	1,558.2	1,527.2	1,524.0	1,529.0	1,549.5	1,585.9	1,601.8	1,599.9	1,598.7	1,589.7	1,579.5	1,579.6	1,524.0
2005	Max	1,586.8	1,585.6	1,573.7	1,576.0	1,591.3	1,597.8	1,601.7	1,602.1	1,600.8	1,593.3	1,587.3	1,571.6	1,602.1
	Ave	1,580.4	1,579.9	1,570.7	1,570.3	1,584.1	1,594.5	1,600.3	1,601.8	1,596.7	1,591.0	1,578.2	1,566.0	1,584.5
	Min	1,572.4	1,574.1	1,569.4	1,569.0	1,576.4	1,591.7	1,598.2	1,601.1	1,592.7	1,588.0	1,572.1	1,560.9	1,560.9
2006	Max	1,571.3	1,560.3	1,533.0	1,505.1	1,560.9	1,598.1	1,602.4	1,602.3	1,601.0	1,594.4	1,598.7	1,589.1	1,602.4
	Ave	1,567.7	1,548.6	1,512.6	1,496.7	1,529.7	1,583.6	1,601.2	1,602.0	1,598.2	1,591.5	1,593.1	1,586.7	1,567.8
	Min	1,560.8	1,534.1	1,495.1	1,493.5	1,506.5	1,561.7	1,598.5	1,601.2	1,594.6	1,588.9	1,588.6	1,583.7	1,493.5
2007	Max	1,584.1	1,564.5	1,548.8	1,550.6	1,583.1	1,602.2	1,602.3	1,601.8	1,600.4	1,593.2	1,585.4	1,586.2	1,602.3
	Ave	1,577.0	1,552.8	1,541.8	1,548.6	1,563.1	1,599.1	1,602.0	1,601.3	1,597.5	1,590.7	1,582.0	1,583.5	1,578.5
	Min	1,565.4	1,541.8	1,533.5	1,546.0	1,548.1	1,585.3	1,601.6	1,600.5	1,593.3	1,585.8	1,578.6	1,577.9	1,533.5
2008	Max	1,579.2	1,553.2	1,527.4	1,502.9	1,564.7	1,600.1	1,601.6	1,602.0	1,601.5	1,592.7	1,590.8	1,587.4	1,602.0
	Ave	1,568.0	1,538.9	1,51,5.5	1,494.7	1,519.2	1,584.2	1,601.3	1,601.6	1,597.7	1,589.0	1,587.8	1,581.8	1,565.1
	Min	1,554.1	1,527.6	1,504.0	1,488.8	1,489.6	1,567.0	1,601.0	1,601.0	1,593.1	1,584.7	1,583.6	1,576.2	1,488.8
2009	Max	1,575.9	1,567.8	1,552.3	1,542.5	1,578.1	1,601.9	1,602.2	1,602.0	1,601.0	1,596.7	1,596.1	1,589.3	1,602.2
	Ave	1,573.2	1,559.8	1,546.9	1,539.9	1,555.7	1,597.4	1,601.6	1,601.1	1,599.3	1,594.5	1,593.3	1,583.8	1,579.0
	Min	1,568.3	1,552.7	1,541.9	1,538.2	1,542.8	1,580.3	1,601.1	1,600.4	1,597.0	1,592.2	1,589.5	1,577.7	1,538.2

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2010	Max	1,577.4	1,569.3	1,556.9	1,547.2	1,567.4	1,600.0	1,601.8	1,601.8	1,600.3	1,598.3	1,583.5	1,579.3	1,601.8
	Ave	1,573.9	1,562.5	1,552.0	1,544.9	1,554.1	1,586.9	1,601.0	1,601.2	1,598.4	1,593.4	1,582.2	1,577.7	1,577.5
	Min	1,570.0	1,557.2	1,547.5	1,542.5	1,547.1	1,568.8	1,599.9	1,600.3	1,596.9	1,582.8	1,578.8	1,575.8	1,542.5
2011	Max	1,576.7	1,570.7	1,551.3	1,524.7	1,534.9	1,586.5	1,602.3	1,602.2	1,600.2	1,595.9	1,590.8	1,583.1	1,602.3
	Ave	1,573.4	1,562.8	1,536.5	1,518.5	1,51,5.6	1,565.1	1,598.0	1,601.2	1,597.0	1,593.6	1,584.0	1,577.7	1,568.7
	Min	1,569.7	1,552.3	1,524.4	1,508.8	1,505.7	1,536.7	1,587.7	1,600.3	1,594.9	1,591.1	1,580.3	1,573.1	1,505.7
2012	Max	1,574.9	1,561.9	1,535.1	1,529.1	1,563.0	1,589.5	1,601.6	1,601.5	1,599.7	1,595.7	1,596.3	1,586.6	1,601.6
	Ave	1,570.2	1,549.3	1,521.8	1,511.9	1,544.4	1,580.1	1,598.4	1,600.8	1,597.1	1,592.1	1,590.5	1,582.1	1,570.0
	Min	1,562.5	1,536.1	1,512.0	1,506.3	1,530.4	1,564.7	1,590.8	1,599.9	1,593.7	1,589.5	1,586.7	1,574.4	1,506.3
2013	Max	1,573.6	1,545.7	1,520.5	1,521.2	1,571.5	1,595.4	1,601.8	1,601.7	1,601.4	1,601.8	1,590.5	1,581.2	1,601.8
	Ave	1,560.4	1,533.2	1,517.1	1,518.7	1,550.5	1,584.9	1,600.5	1,600.8	1,600.5	1,596.8	1,585.8	1,574.2	1,568.9
	Min	1,546.6	1,521.0	1,512.6	1,512.7	1,520.0	1,572.1	1,596.5	1,599.9	1,598.8	1,590.9	1,581.2	1,566.3	1,512.6
2014	Max	1,565.7	1,557.2	1,543.7	1,539.5	1,579.0	1,601.8	1,602.2	1,601.4	1,599.9	1,592.8	1,591.6	1,590.5	1,602.2
	Ave	1,561.7	1,549.5	1,541.7	1,536.6	1,556.2	1,595.1	1,601.6	1,600.7	1,596.1	1,590.0	1,588.7	1,588.6	1,575.7
	Min	1,557.7	1,542.3	1,539.7	1,534.5	1,534.9	1,580.1	1,600.7	1,600.1	1,593.0	1,588.2	1,584.9	1,586.9	1,534.5
2015	Max	1,586.2	1,585.8	1,577.3	1,572.9	1,591.7	1,598.4	1,599.5	1,597.0	1,597.8	1,588.6	1,590.6	1,589.3	1,599.5
	Ave	1,580.7	1,582.3	1,571.4	1,571.7	1,579.0	1,596.8	1,598.6	1,596.7	1,593.8	1,583.4	1,585.2	1,586.3	1,585.5
	Min	1,576.8	1,577.4	1,569.1	1,570.7	1,571.4	1,592.5	1,596.8	1,596.1	1,589.1	1,578.3	1,580.3	1,581.3	1,569.1
2016	Max	1,580.3	1,565.0	1,559.5	1,571.3	1,592.7	1,601.5	1,601.8	1,601.7	1,599.2	1,588.3	1,587.6	1,586.2	1,601.8
	Ave	1,567.4	1,561.8	1,552.2	1,555.9	1,586.1	1,598.5	1,601.3	1,600.7	1,594.2	1,586.6	1,585.7	1,580.1	1,580.9
	Min	1,558.4	1,558.2	1,544.9	1,544.8	1,571.9	1,592.6	1,601.0	1,599.3	1,588.8	1,585.2	1,583.1	1,570.9	1,544.8
2017	Max	1,569.9	1,546.5	1,544.6	1,544.5	1,580.5	1,598.0	1,601.1	1,600.0	1,598.1	1,587.5	1,588.3	1,586.5	1,601.1
	Ave	1,555.1	1,545.0	1,541.6	1,543.0	1,556.4	1,591.7	1,600.4	1,598.7	1,594.0	1,583.1	1,579.9	1,579.2	1,572.5
	Min	1,546.4	1,543.0	1,536.5	1,540.8	1,540.0	1,582.8	1,598.6	1,598.0	1,587.9	1,580.6	1,573.8	1,573.9	1,536.5
2018	Max	1,573.5	1,557.6	1,531.7	1,495.8	1,577.6	1,596.6	1,601.6	1,601.6	1,598.2	1,585.9	1,578.5	1,576.8	1,601.6
	Ave	1,565.2	1,551.7	1,502.2	1,485.1	1,541.6	1,586.9	1,600.6	1,599.7	1,592.7	1,579.5	1,576.2	1,574.0	1,563.1
	Min	1,557.7	1,534.0	1,485.2	1,481.3	1,497.5	1,578.3	1,597.0	1,598.3	1,586.2	1,573.2	1,573.2	1,571.5	1,481.3
28-Year Summary	Max	1,589.8	1,585.8	1,577.3	1,576.0	1,592.7	1,602.2	1,602.5	1,602.5	1,601.8	1,602.3	1,602.3	1,601.6	1,602.5
	Ave	1,568.2	1,553.1	1,535.3	1,528.6	1,548.3	1,585.1	1,599.8	1,600.0	1,596.0	1,589.8	1,584.7	1,578.8	1,572.4
	Min	1,533.2	1,51,5.8	1,485.2	1,467.1	1,477.7	1,51,5.0	1,578.4	1,584.8	1,578.2	1,571.2	1,566.6	1,552.0	1,467.1

Article 301 of the current Project license addresses flood control operations at Ross Lake. Specifically, City Light is required to:

- Provide storage for flood control: 60,000 acre-feet by November 15; 120,000 acre-feet by December 1 (1,592 feet) and through March 15.
- Release only such flows as are necessary for normal generation at all three Project developments but no more than 5,000 cfs (plus or minus 20 percent allowance for operation latitude) whenever the National Weather Service, Northwest River Forecast Center, forecasts that the natural flow at the gaging station near Concrete, WA will equal or exceed 90,000 cfs, in 8 hours, on a rising stage of flood.
- Surcharge the reservoir if the water surface elevation reaches 1,602.5 feet before flood recession occurs to provide the greatest reduction of discharge downstream.
- Comply with “Details of Regulation for Use of Storage Allocated for Flood Control in Ross Reservoir, Skagit River, WA” (Corps of Engineers, revised May 1967), which is incorporated into the Project license by reference.

License Article 403 addresses recreational uses at Ross Lake and requires that City Light:

- Fill as soon as possible after April 15.
- Achieve full pool by July 31.
- Maintain full pool through Labor Day subject to adequate runoff, anadromous fish protection flows downstream of the Project, flood protection, spill minimization, and firm power generation needs.

Spills are infrequent at Ross Dam due to the large reservoir storage capacity. They are typically associated with gate testing, are of short duration, and average only a few cfs (Table 3.5-2). Over the past five years (2014-2018), Ross Dam has spilled 20 times; 11 of these occurred in August 2015 during the Goodell Creek Wildfire, which disrupted Project operations and transmission.

Table 3.5-2. Ross Dam spill events.

Year	Number of Days with Spill	Average Flow per Spill Day (cfs)
2014	1	<1
2015	12	1,540
2016	4	5
2017	1	<1
2018	2	<1

An estimated 1,500 to 6,000 cubic yards of wood enter Ross Lake annually from the Skagit River and other tributaries during winter high flow events and from shoreline erosion (Zapel 2019). Approximately 0.5 percent of the wood is large trees and 2.5 percent includes rootwads. The remainder (97 percent) are smaller logs, limbs, and bark. Prevailing winds on the reservoir tend to move the debris to the upstream end of Ross Lake. Up until 2010, the wood floating on Ross Lake was collected in the summer and stockpiled in British Columbia and burned in the fall.

Since then, Ross Lake wood is collected each summer and moved to storage pens near Hozomeen or to other smaller storage sites. During the winter some portion of the material is towed to a collection point near Ross Dam. From there it is loaded into a dump truck which transports it down the Ross Haul Road. It is then barged across Diablo Lake and taken to the Aggregate Storage Facility where it is stored until it can be placed in the river. Due to the limited work window and resources available for this transport method, it is not possible to move all wood from Ross Lake annually. An estimated 27 acre-feet, or 443,559 cubic yards, of woody debris is currently stored at the head of the lake near Hozomeen and in a few other inlets. At Hozomeen the stored material covers a surface area of about nine acres. Some of the wood has been stored in the inlets and permanently left for weed suppression.

3.5.1.2 Diablo Development

The primary function of Diablo Lake is to reregulate flows between the Ross and Gorge developments. The storage capacity of Diablo Lake is 50,000 acre-feet at a normal operating water surface elevation of about 1,205 feet. The lake typically fluctuates only 4-5 feet daily although drawdowns of 10-12 feet occur occasionally as needed for construction projects or maintenance. Monthly minimum, average, and maximum water surface elevations at Diablo Lake for the period 1991–2018 are provided in Table 3.5-3. The lowest water surface elevation recorded in the current Project license period was 1,193 feet in September 2017, but drawdowns to this level are relatively rare because of constraints related to marine facility specifications and recreational uses. Like Gorge, Diablo Lake can be lowered through spill or generation to provide some additional usable storage in advance of a predicted flood.

Table 3.5-3. Monthly and annual maximum, average, and minimum water surface elevations (feet) at Diablo Dam.

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1991	Max	1,204.3	1,204.8	1,203.8	1,205.4	1,204.9	1,205.3	1,205.7	1,205.1	1,205.0	1,204.6	1,203.3	1,202.9	1,205.7
	Ave	1,201.7	1,202.3	1,202.8	1,201.8	1,202.8	1,202.6	1,203.5	1,203.2	1,203.3	1,202.1	1,201.9	1,201.7	1,202.5
	Min	1,197.7	1,199.2	1,200.8	1,197.9	1,200.4	1,200.0	1,200.6	1,200.3	1,199.5	1,200.4	1,200.5	1,199.8	1,197.7
1992	Max	1,204.4	1,203.9	1,204.8	1,203.9	1,203.5	1,203.6	1,204.9	1,203.8	1,203.4	1,200.4	1,203.9	1,204.1	1,204.9
	Ave	1,203.0	1,202.5	1,202.9	1,202.5	1,202.6	1,202.9	1,202.7	1,202.6	1,199.9	1,189.8	1,202.2	1,201.9	1,201.3
	Min	1,201.2	1,200.7	1,201.6	1,200.4	1,201.8	1,202.0	1,201.2	1,200.7	1,183.9	1,182.7	1,199.4	1,198.1	1,182.7
1993	Max	1,202.5	1,203.6	1,203.9	1,204.2	1,204.4	1,204.4	1,203.2	1,204.1	1,203.9	1,204.1	1,204.2	1,204.0	1,204.4
	Ave	1,201.0	1,202.4	1,202.6	1,203.2	1,202.6	1,202.7	1,202.5	1,202.8	1,203.0	1,203.0	1,202.4	1,202.3	1,202.5
	Min	1,197.7	1,200.6	1,201.3	1,202.4	1,200.3	1,201.3	1,201.0	1,201.1	1,202.0	1,201.4	1,200.6	1,198.6	1,197.7
1994	Max	1,203.8	1,204.5	1,203.7	1,204.0	1,203.8	1,203.6	1,204.2	1,204.0	1,203.9	1,203.8	1,204.0	1,204.1	1,204.5
	Ave	1,202.5	1,202.6	1,202.0	1,202.3	1,202.6	1,202.3	1,202.3	1,202.2	1,202.6	1,201.7	1,202.0	1,202.3	1,202.3
	Min	1,198.9	1,199.5	1,198.6	1,200.0	1,200.4	1,199.9	1,200.1	1,198.4	1,201.2	1,200.1	1,200.6	1,201.0	1,198.4
1995	Max	1,203.6	1,203.3	1,203.1	1,204.0	1,204.3	1,204.2	1,204.9	1,204.8	1,203.3	1,203.7	1,204.2	1,203.7	1,204.9
	Ave	1,202.0	1,201.8	1,201.8	1,199.5	1,202.5	1,202.5	1,202.7	1,202.4	1,202.3	1,202.1	1,201.9	1,201.6	1,201.9
	Min	1,200.6	1,198.7	1,198.3	1,196.7	1,199.4	1,199.8	1,200.5	1,199.8	1,201.3	1,199.9	1,199.6	1,198.7	1,196.7
1996	Max	1,203.7	1,203.3	1,203.8	1,204.1	1,204.8	1,203.9	1,204.2	1,204.8	1,203.8	1,203.9	1,204.2	1,203.0	1,204.8
	Ave	1,202.4	1,201.6	1,202.0	1,202.1	1,202.9	1,202.2	1,202.7	1,202.4	1,202.2	1,199.5	1,201.7	1,201.3	1,201.9
	Min	1,200.5	1,197.8	1,200.5	1,198.2	1,201.1	1,198.7	1,200.8	1,201.1	1,200.2	1,195.5	1,200.3	1,199.4	1,195.5
1997	Max	1,203.4	1,203.3	1,204.5	1,205.0	1,205.4	1,205.7	1,205.5	1,205.3	1,204.8	1,205.4	1,204.0	1,203.3	1,205.7
	Ave	1,201.4	1,202.3	1,202.7	1,202.7	1,202.8	1,203.1	1,203.3	1,203.1	1,203.0	1,202.4	1,201.9	1,202.1	1,202.6
	Min	1,200.1	1,201.3	1,201.1	1,201.1	1,200.3	1,200.7	1,201.7	1,201.2	1,201.4	1,199.0	1,199.1	1,201.2	1,199.0
1998	Max	1,203.1	1,203.3	1,203.5	1,204.1	1,204.2	1,204.2	1,203.6	1,203.9	1,203.7	1,203.3	1,202.8	1,202.8	1,204.2
	Ave	1,201.8	1,202.0	1,202.1	1,202.7	1,202.2	1,202.8	1,202.6	1,201.8	1,201.6	1,201.9	1,201.7	1,200.8	1,202.0
	Min	1,199.6	1,200.7	1,199.8	1,200.8	1,200.7	1,200.7	1,200.9	1,200.2	1,199.3	1,200.4	1,200.8	1,198.0	1,198.0
1999	Max	1,204.8	1,204.0	1,204.3	1,203.1	1,204.8	1,203.7	1,205.4	1,205.4	1,204.5	1,204.7	1,205.1	1,204.6	1,205.4
	Ave	1,202.2	1,202.0	1,201.7	1,201.2	1,202.9	1,202.2	1,203.1	1,203.2	1,203.2	1,203.0	1,203.0	1,202.9	1,202.5
	Min	1,199.5	1,199.2	1,198.8	1,198.6	1,200.7	1,200.0	1,201.0	1,199.2	1,201.9	1,200.7	1,201.2	1,200.8	1,198.6

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2000	Max	1,204.3	1,204.0	1,204.8	1,204.3	1,204.6	1,205.4	1,204.4	1,205.3	1,204.4	1,203.8	1,205.0	1,202.9	1,205.4
	Ave	1,203.1	1,202.8	1,203.0	1,202.4	1,202.3	1,202.6	1,202.8	1,203.2	1,202.4	1,202.2	1,202.7	1,201.8	1,202.6
	Min	1,200.4	1,202.0	1,201.9	1,200.7	1,200.4	1,200.8	1,200.6	1,200.4	1,200.3	1,200.8	1,200.9	1,200.6	1,200.3
2001	Max	1,204.3	1,203.9	1,204.1	1,203.9	1,204.4	1,204.8	1,204.4	1,204.7	1,204.3	1,203.4	1,202.8	1,202.5	1,204.8
	Ave	1,202.3	1,202.4	1,202.7	1,202.5	1,202.5	1,203.0	1,203.0	1,203.1	1,203.2	1,202.3	1,201.4	1,201.2	1,202.5
	Min	1,200.8	1,200.6	1,200.9	1,201.0	1,200.7	1,201.0	1,201.5	1,200.8	1,201.7	1,200.9	1,199.7	1,199.4	1,199.4
2002	Max	1,204.6	1,203.8	1,204.1	1,203.4	1,204.8	1,203.9	1,204.9	1,203.1	1,202.3	1,203.0	1,201.8	1,202.9	1,204.9
	Ave	1,201.8	1,202.4	1,202.4	1,202.2	1,202.1	1,202.1	1,202.9	1,200.5	1,200.6	1,201.5	1,200.2	1,201.6	1,201.7
	Min	1,199.8	1,200.2	1,200.7	1,199.5	1,199.6	1,199.3	1,200.5	1,197.4	1,197.8	1,199.1	1,197.8	1,200.1	1,197.4
2003	Max	1,204.3	1,202.6	1,202.0	1,204.2	1,204.7	1,203.9	1,204.7	1,203.7	1,203.8	1,204.1	1,203.2	1,203.9	1,204.7
	Ave	1,201.5	1,201.6	1,201.0	1,201.9	1,202.6	1,202.3	1,202.4	1,202.2	1,202.3	1,202.0	1,201.9	1,202.2	1,202.0
	Min	1,200.1	1,199.6	1,199.3	1,200.2	1,200.5	1,200.6	1,200.0	1,201.1	1,200.6	1,200.6	1,199.9	1,200.8	1,199.3
2004	Max	1,203.8	1,203.9	1,204.8	1,203.9	1,204.5	1,205.0	1,204.3	1,205.3	1,204.8	1,203.6	1,204.2	1,204.1	1,205.3
	Ave	1,202.5	1,202.8	1,202.8	1,202.5	1,202.7	1,202.7	1,202.9	1,203.2	1,202.9	1,202.5	1,202.8	1,202.8	1,202.8
	Min	1,200.7	1,200.9	1,201.6	1,201.1	1,199.6	1,200.9	1,201.0	1,200.8	1,201.3	1,201.1	1,201.2	1,200.6	1,199.6
2005	Max	1,204.2	1,204.4	1,204.0	1,203.7	1,203.5	1,202.0	1,204.3	1,203.8	1,204.6	1,204.3	1,203.3	1,204.0	1,204.6
	Ave	1,202.1	1,203.0	1,202.6	1,202.2	1,199.2	1,198.5	1,202.6	1,202.7	1,202.5	1,202.3	1,201.2	1,201.9	1,201.7
	Min	1,198.5	1,202.2	1,200.4	1,199.0	1,196.4	1,196.9	1,200.3	1,201.3	1,200.9	1,198.0	1,198.5	1,199.1	1,196.4
2006	Max	1,203.5	1,203.4	1,203.6	1,203.0	1,205.1	1,204.3	1,204.4	1,204.5	1,204.1	1,204.2	1,204.3	1,203.6	1,205.1
	Ave	1,201.6	1,202.0	1,201.7	1,201.7	1,202.2	1,202.7	1,202.8	1,203.2	1,202.8	1,203.0	1,202.1	1,202.2	1,202.3
	Min	1,200.0	1,200.6	1,200.0	1,199.6	1,200.1	1,200.6	1,200.6	1,202.2	1,201.5	1,200.2	1,200.0	1,201.2	1,199.6
2007	Max	1,203.9	1,203.4	1,203.7	1,203.6	1,203.6	1,204.7	1,204.8	1,204.1	1,203.3	1,204.0	1,203.7	1,202.6	1,204.8
	Ave	1,201.4	1,201.7	1,201.9	1,201.7	1,202.3	1,202.7	1,203.4	1,202.4	1,201.9	1,202.1	1,201.6	1,201.4	1,202.0
	Min	1,200.2	1,200.6	1,199.3	1,200.1	1,201.4	1,200.8	1,201.4	1,199.2	1,199.8	1,200.1	1,200.5	1,200.4	1,199.2
2008	Max	1,202.9	1,204.2	1,203.5	1,203.6	1,204.3	1,203.9	1,204.7	1,203.6	1,203.6	1,203.5	1,203.2	1,203.7	1,204.7
	Ave	1,201.6	1,202.6	1,202.1	1,201.4	1,202.5	1,201.6	1,201.6	1,202.2	1,202.1	1,201.7	1,201.5	1,202.4	1,201.9
	Min	1,200.6	1,201.3	1,200.5	1,198.4	1,200.6	1,200.2	1,197.1	1,200.9	1,199.8	1,200.0	1,198.6	1,200.6	1,197.1
2009	Max	1,203.4	1,203.1	1,203.1	1,204.5	1,203.7	1,204.1	1,204.0	1,203.4	1,203.5	1,203.8	1,204.8	1,202.9	1,204.8
	Ave	1,201.8	1,202.0	1,201.8	1,201.0	1,202.1	1,202.6	1,202.5	1,202.0	1,201.6	1,201.4	1,201.2	1,201.3	1,201.8
	Min	1,199.5	1,201.0	1,199.7	1,198.3	1,200.1	1,201.1	1,201.1	1,200.8	1,200.6	1,200.2	1,199.3	1,199.9	1,198.3

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2010	Max	1,202.5	1,202.8	1,202.5	1,204.1	1,203.9	1,202.6	1,204.6	1,203.8	1,204.4	1,203.4	1,202.4	1,203.1	1,204.6
	Ave	1,201.1	1,201.5	1,201.3	1,201.5	1,201.8	1,201.4	1,202.2	1,201.8	1,202.8	1,201.6	1,200.4	1,201.3	1,201.5
	Min	1,199.9	1,200.5	1,200.2	1,200.3	1,200.4	1,200.4	1,199.4	1,200.3	1,200.6	1,200.1	1,198.2	1,199.4	1,198.2
2011	Max	1,203.6	1,202.5	1,203.3	1,202.6	1,203.4	1,202.9	1,204.4	1,203.3	1,203.3	1,202.5	1,203.5	1,201.1	1,204.4
	Ave	1,201.6	1,201.6	1,201.7	1,200.9	1,201.5	1,201.5	1,202.4	1,201.8	1,201.5	1,201.2	1,201.3	1,200.5	1,201.5
	Min	1,200.1	1,200.8	1,199.1	1,198.9	1,198.6	1,200.1	1,200.3	1,198.1	1,200.2	1,200.6	1,199.6	1,198.6	1,198.1
2012	Max	1,202.1	1,201.9	1,202.5	1,203.6	1,202.3	1,203.5	1,203.6	1,203.3	1,203.6	1,204.8	1,202.3	1,201.9	1,204.8
	Ave	1,201.0	1,200.9	1,200.7	1,201.7	1,200.9	1,201.4	1,202.1	1,201.4	1,201.6	1,201.2	1,201.0	1,200.8	1,201.2
	Min	1,200.3	1,200.1	1,199.6	1,199.6	1,199.6	1,199.9	1,200.9	1,199.9	1,200.6	1,200.0	1,200.1	1,200.0	1,199.6
2013	Max	1,202.7	1,202.9	1,202.1	1,202.0	1,202.5	1,202.8	1,202.3	1,202.9	1,202.4	1,204.2	1,201.8	1,202.3	1,204.2
	Ave	1,201.4	1,201.2	1,200.8	1,200.9	1,201.3	1,201.5	1,201.2	1,201.4	1,201.1	1,201.5	1,201.0	1,201.3	1,201.2
	Min	1,200.5	1,200.1	1,199.8	1,200.1	1,199.9	1,200.0	1,200.2	1,200.3	1,200.3	1,199.7	1,199.7	1,200.4	1,199.7
2014	Max	1,202.2	1,202.2	1,202.4	1,202.3	1,202.8	1,204.1	1,204.0	1,204.0	1,203.3	1,202.5	1,204.0	1,202.8	1,204.1
	Ave	1,201.3	1,201.2	1,200.7	1,201.0	1,201.2	1,202.1	1,201.9	1,202.3	1,202.1	1,200.7	1,201.2	1,200.9	1,201.4
	Min	1,200.4	1,200.0	1,199.3	1,199.1	1,199.7	1,200.4	1,200.3	1,200.9	1,199.2	1,198.3	1,200.0	1,199.8	1,198.3
2015	Max	1,203.3	1,203.7	1,202.9	1,203.0	1,203.2	1,203.3	1,203.4	1,203.0	1,202.6	1,202.1	1,204.1	1,202.5	1,204.1
	Ave	1,202.0	1,201.4	1,201.7	1,202.0	1,200.5	1,199.8	1,201.7	1,201.6	1,200.0	1,195.5	1,199.1	1,200.6	1,200.5
	Min	1,200.8	1,199.9	1,199.6	1,200.3	1,196.7	1,196.7	1,199.6	1,199.2	1,194.6	1,194.2	1,195.3	1,198.4	1,194.2
2016	Max	1,204.4	1,202.6	1,203.6	1,202.9	1,203.6	1,204.7	1,204.0	1,204.3	1,202.4	1,204.2	1,202.3	1,202.3	1,204.7
	Ave	1,201.7	1,201.1	1,201.5	1,200.8	1,201.7	1,202.8	1,202.3	1,202.2	1,201.0	1,200.6	1,200.8	1,201.3	1,201.5
	Min	1,200.4	1,200.0	1,200.4	1,194.3	1,199.6	1,200.9	1,200.8	1,200.4	1,199.7	1,198.2	1,198.3	1,199.7	1,194.3
2017	Max	1,202.5	1,203.5	1,202.8	1,202.6	1,204.0	1,204.1	1,204.0	1,202.9	1,202.1	1,202.6	1,203.0	1,203.5	1,204.1
	Ave	1,201.3	1,201.4	1,201.1	1,200.8	1,201.7	1,201.9	1,201.9	1,200.8	1,197.5	1,200.3	1,199.8	1,201.5	1,200.8
	Min	1,199.6	1,199.5	1,199.5	1,199.6	1,199.9	1,199.7	1,200.8	1,194.9	1,193.3	1,195.7	1,196.6	1,200.3	1,193.3
2018	Max	1,202.2	1,201.9	1,202.0	1,201.7	1,203.7	1,203.0	1,202.8	1,203.3	1,202.3	1,202.5	1,203.0	1,202.3	1,203.7
	Ave	1,200.7	1,200.5	1,201.2	1,200.7	1,201.6	1,201.5	1,201.4	1,201.3	1,201.2	1,201.3	1,200.6	1,200.8	1,201.1
	Min	1,197.6	1,198.4	1,199.9	1,199.4	1,199.5	1,199.5	1,200.3	1,199.8	1,200.3	1,198.7	1,199.3	1,199.5	1,197.6
28-Year Summary	Max	1,204.8	1,204.8	1,204.8	1,205.4	1,205.4	1,205.7	1,205.7	1,205.4	1,205.0	1,205.4	1,205.1	1,204.6	1,205.7
	Ave	1,201.8	1,201.9	1,201.9	1,201.7	1,202.0	1,202.1	1,202.5	1,202.3	1,201.9	1,201.1	1,201.4	1,201.6	1,201.8
	Min	1,197.6	1,197.8	1,198.3	1,194.3	1,196.4	1,196.7	1,197.1	1,194.9	1,183.9	1,182.7	1,195.3	1,198.0	1,182.7

Because of its role as a reregulation facility, Diablo Lake spills more frequently than either of the other Project reservoirs (Figure 3.5-3). With usable storage limited to 8,820 acre-feet, spill can occur any time inflow to the reservoir exceeds plant capacity, typically during periods of high runoff, particularly during the spring or early summer. However, Diablo also spills when units are off-line at the powerhouse or when additional water is needed to meet flow requirements downstream of Gorge. Over the past five years, the number of days per year with recorded spill events has varied greatly (Table 3.5-4). Under typical operations, represented by 2014-2016, Diablo Dam spills an average of 30 days per year. However, in years when unit maintenance occurs at Diablo Powerhouse, such as 2017 and 2018, spill events are significantly more frequent and of longer duration.

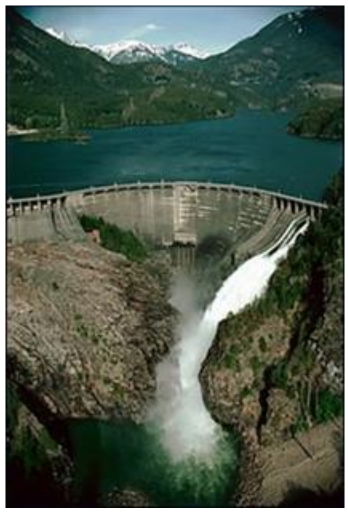

Figure 3.5-3. Spill at Diablo Dam.

Table 3.5-4. Diablo Dam spill events.

Year	Number of Days with Spill	Average Flow per Spill Day (cfs)
2014	90	1,704
2015	28	923
2016	44	1,333
2017	223	1,370
2018	274	1,393

The amount of wood entering Diablo Lake is very small compared to Ross Lake; the majority originates in Thunder Creek, with minor contributions from the other tributaries and the lake shore. Logs, rootwads, and woody debris that enter Diablo Lake are collected throughout the year and temporarily stored in a pen at Buster Brown Cove, then towed to a collection point near the mouth of Sourdough Creek and extracted using an excavator. The wood is transported via dump truck to the Aggregate Storage Facility south of Newhalem and then placed into the Skagit River from October through April to allow higher flows to transport the wood.

3.5.1.3 Gorge Development

The primary function of Gorge Lake is to regulate downstream flows for fish protection. It has a gross storage capacity of 8,500 acre-feet at normal maximum water surface elevation of 875 feet; usable storage is only 6,600 acre-feet. Because of its relatively low storage volume, unplanned spills at the dam can occur any time inflow exceeds generation capacity. In addition, because flows from the Gorge Development are critical for fish protection in the Skagit River, water from the reservoir is spilled if the powerhouse is not generating enough to maintain downstream minimum flow requirements. Over the past five years, Gorge Dam has spilled between 14 and 61 days annually, with an average flow of 1,925 cfs (Table 3.5-5).

Table 3.5-5. Gorge Dam spill events.

Year	Number of Days with Spill	Average Flow per Spill Day (cfs)
2014	61	2,257
2015	14	727
2016	43	1,649
2017	36	2,062
2018	42	2,933

Monthly minimum, average, and maximum water surface elevations at Gorge Lake for the period 1991–2018 are provided in Table 3.5-6. Gorge Lake typically fluctuates only 3-5 feet, but drawdowns of 50 feet are occasionally needed for spill gate maintenance or inspection. The lowest water surface elevation recorded within the current Project license period was 782 feet in August 1997. An extended drawdown (817-820 feet) for spill gate painting occurred in 2013; another much shorter drawdown for spill gate testing occurred in 2019. In addition, Gorge Lake is drawn down, via spill or generation, to provide some additional usable storage in advance of a predicted flood event.

Logs, rootwads, and woody debris that accumulate in Gorge Lake are passed downstream via a log chute in the dam. Approximately 150 to 250 cubic yards of woody debris is passed annually, typically when the dam is spilling, which facilitates movement downstream.

Table 3.5-6. Monthly and annual maximum, average, and minimum water surface elevations (feet) at Gorge Dam.

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1991	Max	874.0	875.5	873.6	874.5	876.9	876.7	878.6	877.1	878.1	873.9	873.9	873.9	878.6
	Ave	872.5	872.8	872.6	872.5	874.5	874.4	875.8	874.3	873.3	872.6	872.9	872.3	873.4
	Min	869.3	866.9	870.5	870.0	872.2	869.8	872.2	870.7	870.9	870.3	870.8	871.3	866.9
1992	Max	874.3	874.2	874.5	874.4	874.1	873.5	874.0	873.9	873.6	873.9	874.2	874.1	874.5
	Ave	873.0	873.2	872.3	872.7	872.6	872.6	872.8	872.4	872.7	872.9	872.6	872.6	872.7
	Min	871.9	871.2	837.1	870.5	871.0	871.0	871.1	870.8	871.9	871.1	869.2	870.6	837.1
1993	Max	874.0	873.7	874.5	874.4	874.6	874.0	873.4	873.6	873.6	873.9	873.9	874.3	874.6
	Ave	872.1	872.2	872.8	873.4	873.1	873.0	872.5	864.8	872.6	872.9	873.0	873.0	872.1
	Min	869.6	870.7	871.2	872.4	870.1	872.2	871.0	819.8	869.5	871.6	872.1	871.7	819.8
1994	Max	873.9	874.5	874.5	874.0	874.0	873.9	874.0	874.0	873.6	873.4	874.8	873.9	874.8
	Ave	872.9	873.3	873.0	873.2	873.0	872.6	872.3	872.3	872.6	872.5	872.5	872.7	872.7
	Min	870.4	870.2	869.9	871.9	871.2	871.7	869.9	869.1	870.4	871.1	870.8	870.3	869.1
1995	Max	874.0	874.9	873.7	874.0	874.2	874.2	874.2	874.6	873.3	874.8	879.3	875.0	879.3
	Ave	872.1	871.8	872.8	873.0	873.3	872.8	872.8	872.1	872.3	872.6	872.0	871.8	872.5
	Min	869.8	868.0	871.8	871.0	872.4	870.3	870.8	868.9	870.7	870.3	864.2	867.2	864.2
1996	Max	874.6	874.4	874.4	874.7	874.9	874.4	874.6	874.4	873.8	874.6	874.7	874.0	874.9
	Ave	872.4	872.7	872.6	873.2	873.8	873.1	872.8	872.4	872.4	872.8	872.7	872.5	872.8
	Min	870.3	870.3	868.8	871.8	872.3	871.8	868.3	870.9	870.3	871.6	871.0	871.5	868.3
1997	Max	874.4	873.9	874.2	874.4	877.3	878.3	877.6	874.9	874.8	877.2	877.6	874.5	878.3
	Ave	871.5	872.8	872.8	873.2	873.9	874.0	874.8	837.0	873.2	873.3	873.6	872.6	870.2
	Min	869.2	871.8	871.5	871.8	871.4	870.4	871.6	782.0	870.9	870.6	869.6	870.9	782.0
1998	Max	873.4	874.1	874.8	874.6	874.0	874.8	874.7	874.1	874.4	873.3	874.0	873.4	874.8
	Ave	872.3	872.9	872.7	873.2	872.4	872.7	872.8	872.3	872.0	872.0	872.0	871.4	872.4
	Min	870.5	871.5	870.4	872.4	870.5	870.3	870.6	871.3	869.5	870.0	870.1	868.4	868.4
1999	Max	873.9	874.7	874.9	873.8	874.8	874.8	878.8	877.1	874.3	874.8	874.5	874.6	878.8
	Ave	872.5	872.7	872.9	872.9	873.0	872.8	873.7	873.2	872.6	872.0	872.9	873.0	872.8
	Min	870.2	870.7	871.2	871.5	868.5	870.1	871.1	869.5	870.2	869.3	870.6	870.3	868.5

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2000	Max	874.1	873.7	873.5	873.5	874.8	874.6	874.5	874.2	873.2	872.7	873.2	874.2	874.8
	Ave	872.5	872.8	872.7	871.7	873.6	872.9	872.1	872.2	871.5	870.9	871.1	871.7	872.1
	Min	869.2	871.3	870.9	868.5	871.2	870.1	868.4	869.7	869.8	869.2	868.1	869.6	868.1
2001	Max	873.9	873.0	872.9	872.3	874.5	873.9	872.2	871.6	872.1	871.5	872.2	872.7	874.5
	Ave	872.0	871.4	871.2	870.9	871.1	870.6	869.9	869.8	869.8	870.3	870.4	870.5	870.6
	Min	870.0	870.0	869.0	869.3	869.3	868.7	867.9	867.6	868.4	868.8	867.5	868.7	867.5
2002	Max	877.5	874.4	873.8	873.4	874.4	877.3	877.1	874.0	873.7	873.6	872.5	873.6	877.5
	Ave	871.6	872.3	869.8	871.6	871.5	873.6	874.7	871.9	871.8	871.2	871.1	871.7	871.9
	Min	869.8	870.0	851.6	868.4	867.3	868.7	870.9	869.5	870.5	869.2	869.7	870.6	851.6
2003	Max	874.3	874.7	874.0	873.1	874.5	874.5	876.8	873.6	872.9	876.0	873.8	874.6	876.8
	Ave	872.2	871.9	871.4	871.4	871.8	872.1	872.4	871.5	871.4	871.8	858.8	870.2	870.6
	Min	869.8	869.6	868.9	869.8	869.7	869.5	870.3	870.0	870.1	869.7	820.2	853.0	820.2
2004	Max	874.1	873.8	873.6	873.5	874.5	875.1	874.1	874.9	874.2	874.2	874.3	874.1	875.1
	Ave	872.1	872.3	872.2	872.1	872.6	872.9	872.6	872.3	871.9	872.0	872.0	872.4	872.3
	Min	870.0	871.1	870.1	870.4	870.9	870.5	870.4	870.7	870.9	869.1	870.0	870.5	869.1
2005	Max	874.5	874.0	873.8	873.6	874.7	873.9	872.7	872.9	875.5	874.6	873.6	874.2	875.5
	Ave	872.0	872.9	872.1	871.6	872.2	872.0	871.5	871.5	871.6	872.4	872.0	872.1	872.0
	Min	869.5	871.3	871.0	869.8	869.5	870.0	867.6	869.8	870.5	870.3	870.1	869.4	867.6
2006	Max	873.6	874.3	874.4	873.4	876.3	876.9	877.1	873.4	873.5	873.3	874.2	873.1	877.1
	Ave	871.9	872.4	872.6	871.9	872.0	873.1	874.3	871.5	871.8	871.7	872.2	871.8	872.3
	Min	869.7	870.6	870.6	869.9	868.1	870.3	870.7	870.6	869.4	870.3	870.3	870.6	868.1
2007	Max	873.9	873.7	875.0	874.2	873.8	874.8	875.9	873.4	872.9	874.1	873.0	872.5	875.9
	Ave	871.8	872.5	872.3	872.9	872.2	870.1	873.1	871.7	871.7	872.0	871.4	871.2	871.9
	Min	870.3	871.2	870.1	870.8	870.0	845.7	870.9	870.4	870.8	870.0	870.1	869.1	845.7
2008	Max	873.9	874.3	874.2	873.6	874.1	874.2	875.8	873.9	873.6	874.1	874.2	874.2	875.8
	Ave	872.5	872.7	872.5	872.2	872.4	872.7	873.0	866.8	871.6	872.3	869.6	872.6	871.7
	Min	870.6	870.5	871.0	871.2	869.3	870.5	870.7	824.1	869.3	870.7	854.0	869.9	824.1
2009	Max	873.8	873.8	872.9	874.0	873.7	873.9	874.2	873.8	873.6	873.8	874.0	874.0	874.2
	Ave	869.8	872.1	871.4	871.3	872.2	872.1	871.7	871.7	871.5	869.7	869.3	872.2	871.3
	Min	850.4	871.1	868.5	869.7	870.8	868.7	868.9	869.3	870.2	850.8	855.1	870.2	850.4

Year		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2010	Max	873.7	874.0	873.8	873.0	873.6	874.1	873.5	873.4	873.9	873.4	873.8	872.8	874.1
	Ave	871.8	871.8	871.9	871.4	871.8	872.4	872.3	871.9	872.1	867.5	871.7	870.3	871.4
	Min	870.0	870.2	870.5	869.1	870.4	870.9	870.5	869.8	870.0	861.2	866.1	865.2	861.2
2011	Max	873.5	873.4	873.9	873.3	873.5	873.4	873.9	874.4	873.4	872.9	873.7	872.2	874.4
	Ave	871.3	871.7	871.9	871.8	871.8	871.9	872.0	870.8	871.5	871.2	866.6	871.3	871.2
	Min	868.2	870.7	866.8	867.9	869.5	869.8	870.3	859.7	869.8	869.6	846.1	868.7	846.1
2012	Max	872.1	872.2	873.5	873.9	874.3	874.6	873.5	873.9	872.9	874.6	873.1	872.6	874.6
	Ave	871.2	871.3	870.9	871.3	872.2	871.9	872.2	871.7	872.0	871.4	871.0	871.5	871.6
	Min	870.0	870.0	869.0	869.7	868.9	869.7	869.3	870.3	871.2	869.5	868.5	870.5	868.5
2013	Max	874.4	873.1	873.8	873.1	873.0	873.0	872.4	821.0	822.0	821.7	872.5	872.8	874.4
	Ave	871.8	871.7	871.3	871.4	871.6	871.6	844.5	820.0	819.9	820.8	845.2	871.7	854.2
	Min	869.9	870.7	868.7	869.7	869.9	870.6	818.0	819.1	819.3	820.1	820.3	870.7	818.0
2014	Max	872.8	872.2	873.0	874.0	872.8	874.0	873.3	873.2	872.4	872.2	874.2	872.8	874.2
	Ave	871.3	871.4	870.7	871.4	871.4	871.8	871.7	871.7	871.6	871.1	871.0	870.7	871.3
	Min	869.6	870.3	866.0	870.1	870.0	870.2	870.2	870.5	870.8	869.7	866.7	869.3	866.0
2015	Max	874.1	872.5	873.8	872.7	872.8	873.2	872.9	874.1	873.2	873.5	872.3	872.0	874.1
	Ave	871.7	871.0	871.9	871.3	871.8	871.7	871.3	871.9	871.3	870.7	869.8	870.2	871.2
	Min	870.4	870.0	870.1	869.5	870.2	869.7	870.0	869.9	869.8	870.1	860.6	864.5	860.6
2016	Max	873.3	873.1	872.7	873.4	872.9	873.5	873.2	873.3	873.1	873.2	872.7	873.4	873.5
	Ave	871.5	871.2	871.2	871.3	871.6	871.3	871.7	871.8	871.3	870.0	870.3	871.1	871.2
	Min	870.1	869.3	870.1	868.6	869.3	868.0	870.4	869.8	869.5	865.8	867.4	869.5	865.8
2017	Max	872.8	873.9	874.5	873.7	873.9	872.3	873.1	872.6	872.6	872.5	872.1	873.0	874.5
	Ave	871.2	871.7	871.2	871.3	871.7	870.9	871.1	871.5	871.2	870.3	870.1	871.6	871.1
	Min	868.9	870.0	868.0	869.0	870.1	868.9	869.8	870.2	869.8	865.4	867.7	869.4	865.4
2018	Max	873.1	871.9	872.1	872.6	873.1	872.1	872.3	871.9	872.2	872.1	873.1	872.2	873.1
	Ave	870.9	871.1	871.4	871.2	871.4	871.1	871.1	871.2	871.2	871.4	871.1	871.1	871.2
	Min	868.1	870.4	870.5	869.5	870.1	868.8	869.5	870.3	870.0	869.7	870.2	870.1	868.1
28-Year Summary	Max	877.5	875.5	875.0	874.7	877.3	878.3	878.8	877.1	878.1	877.2	879.3	875.0	879.3
	Ave	871.9	872.2	872.0	872.0	872.4	872.3	871.5	868.4	870.0	869.7	870.0	871.7	871.2
	Min	850.4	866.9	837.1	867.9	867.3	845.7	818.0	782.0	819.3	820.1	820.2	853.0	782.0

3.5.2 River Operations

From 1991 through 2012, flows in the mainstem Skagit River downstream of Gorge Powerhouse were determined by the Project license issued by FERC in 1995 which fully incorporated the measures included in the Flow Plan of the FSA (City Light 1991). The primary purpose of the Flow Plan was to minimize the effects of Project operations on salmon and steelhead. The measures included in the Flow Plan were developed based on extensive research on the effects of Project operations on fish and by hydrological and operational modeling (Pflug and Mobrand 1989). The Flow Plan also established a Flow Plan Coordinating Committee (FCC), which consists of representatives from the tribes and WDFW, to address and approve any deviations from the planned flow measures needed to respond to changing conditions (i.e., flow insufficiency or flood flows).

The Project license was amended in 2013 to incorporate a Revised FSA Flow Plan (City Light 2011), which included four measures City Light had been implementing voluntarily since 1995 to further reduce Project effects on steelhead and salmon. The specific flow measures and ramping rate restrictions included in the Project license as amended (FERC 2013) and the Revised FSA Flow Plan (City Light 2011) are described below by species and life stage.

3.5.2.1 Salmon Spawning and Redd Protection

The primary means of protecting spawning salmon and redds downstream of the Project are to: (1) limit maximum flow levels during spawning to minimize redd building along the edges of the river in areas exposed by daily load following generation; and (2) maintain minimum flows throughout the incubation period to keep redds covered until the fry emerge.

The Revised FSA Flow Plan identifies anticipated spawning periods for each species which are based on historic habitat use data collected by resource agencies and tribes. The spawning periods for each species as identified in the Revised FSA Flow Plan are as follows:

- Chinook Salmon – August 20 to October 15 each year.
- Pink Salmon – September 12 and ends on October 31 in odd years.
- Chum Salmon – November 1 and ends on January 6 each year.

During the spawning period of each salmon species, daily flows may not exceed 4,500 cfs for Chinook Salmon, 4,000 cfs for Pink Salmon, and 4,600 cfs for Chum Salmon unless: (1) the flow forecast made by City Light shows a sufficient volume of water will be available to sustain a higher incubation flow, thereby permitting a higher spawning flow; or (2) uncontrollable flow conditions are present. The seasonal spawning flow for each species is defined as the average of the highest ten daily spawning flows at the Newhalem gage during the spawning period of that species.

In addition, the current Project license requires City Light to provide minimum flows, which are dependent on spawning flows, during the salmon incubation period. For purposes of this requirement, incubation is presumed to begin on the first day of the spawning period identified for each species and end on April 30 for Chinook and Pink Salmon, and May 31 for Chum Salmon. As a result, instantaneous minimum flows are provided from August 20 through May 31 each year (see Appendix C of the Revised FSA; City Light 2011).

3.5.2.2 Salmon Fry Protection

The salmon fry protection period specified in the Revised FSA Flow Plan is January 1 through May 31, which is when salmon fry are emerging from redds and may be subject to stranding on gravel bars (Pflug and Mobrand 1989). Stranding refers to entrapment and death of juvenile salmonids on gravel bars that become exposed (dry) when the river drops rapidly in response to operational changes from a hydroelectric project. The vulnerability of salmonid fry to stranding depends on several biological, temporal, and physical factors, in addition to hydroelectric project operational factors. Stream flow properties include the river's height (stage) in relation to a specific habitat and the rate at which the stage changes in response to stream flow changes. Operational factors control changes in stream flow, which reflect electrical power requirements.

To minimize fry stranding, the Project license requires City Light to limit daily down-ramp amplitude; maintain minimum flows throughout the salmon fry protection period that are adequate to cover gravel bar areas commonly inhabited by salmon fry; and limit down-ramping to nighttime hours except in periods of high flow, as follows:

- **Down-ramp Amplitude –** The down-ramp amplitude is limited to no more than 4,000 cfs.
- **Down-ramping Rate** – During periods of daylight, no down-ramping is allowed from the moment when the flow at Marblemount is predicted to be ≤ 4,700 cfs. Down-ramping may proceed at a rate of up to 1,500 cfs per hour as long as the flow at Marblemount is predicted to be > 4,700 cfs. During periods of darkness, down-ramping is allowed at a rate up to 3,000 cfs per hour.
- **Salmon Fry Protection Release** – To maintain a predicted Marblemount flow of 3,000 cfs during the salmon fry protection period, the Project must release up to 2,600 cfs.

3.5.2.3 Steelhead Spawning and Redd Protection

As is done for salmon, the primary means of protecting spawning steelhead and redds downstream of the Project are to: (1) limit maximum flow levels during spawning to minimize redd building along the edges of the river in areas exposed by daily load following generation; and (2) maintain minimum flows throughout the incubation period to keep redds covered until the fry emerge.

Measures to protect spawning steelhead and redds downstream of the Project include limiting maximum flow levels during spawning; shaping daily flows for uniformity over the extended spawning period; and maintaining minimum flows through the incubation period adequate to keep redds covered until fry emerge from the gravel. To protect eggs and embryos from dewatering, the measures in the Revised FSA Flow Plan substantially reduce the difference between spawning and incubation flows, thus decreasing the area of river channel subjected to dewatering.

The steelhead spawning period specified in the Revised FSA Flow Plan is from March 15 – June 15 each year. This spawning period is divided into three sub-periods: March 15 – 31, April 1 – 30, and May 1 – June 15. Each sub-period is treated separately for the purpose of determining succeeding steelhead spawning and incubation flows. Planned flows may not exceed 5,000 cfs for March steelhead, 5,000 cfs for April steelhead, and 4,000 cfs for May – June 15 steelhead, unless the forecasted inflow and storage is great enough to provide incubation flows that are at least as high as the spawning flows. As stipulated in the Revised FSA Flow Plan, any planned spawning flows greater than these flow ranges are not to be implemented without prior discussion with the FCC. The actual spawning flow for each sub-period is defined as the average of the ten highest daily spawning flows at the Newhalem gage during that sub-period.

The incubation periods for each steelhead spawning group starts on the first day of the spawning sub-periods and ends on June 30 for March steelhead and July 31 for both April steelhead and May – June 15 steelhead. An instantaneous minimum incubation flow for each day of the incubation period is provided as follows:

- Incubation flows during the first ten days of each spawning sub-period are based on the planned spawning flow.
- Thereafter, daily incubation flows are based on the average of the highest ten daily spawning flows that have occurred up to that day. Appropriate incubation flows for any given day are determined by the season spawning flows in Appendix G of the Revised FSA (City Light 2011).
- During the month of August, the instantaneous daily minimum flow at Newhalem gage is 2,000 cfs.

3.5.2.4 Steelhead Fry Protection

Newly emerged steelhead fry are protected from potential stranding by limiting daily down-ramp amplitudes and rates and by maintaining minimum flows from June 1 – October 15 adequate to cover gravel bar areas commonly inhabited by steelhead fry. Implementation details include:

- **Down-ramp Amplitude** – The maximum 24-hour, down-ramp amplitude is limited to 3,000 cfs when flows at the Newhalem gage are > 4,000 cfs. When flows at Newhalem gage are ≤ 4,000 cfs, the down-ramp amplitude is limited to 2,000 cfs per day from June 1 – August and to 2,500 in September and October. During the month of August, down-ramp amplitude is further restricted to 500 cfs per day when flow insufficiency provisions are in effect (see Revised FSA Section 6.4; City Light 2011).
- **Down-ramping Rate** – When the Newhalem instantaneous flow is ≤ 4,000 cfs, the allowed down-ramp rate is up to 500 cfs per hour. When the Newhalem instantaneous flow remains > 4,000 cfs, a down-ramp rate of up to 1,000 cfs per hour is allowed.
- **Steelhead Fry Protection Flow** – Minimum flows at the Newhalem gage must be the higher of flows specified in Appendix I of the Revised FSA Flow Plan (City Light 2011; Table 3.5-7) or by required steelhead incubation flows. During the portions of June and October excluded from the steelhead fry protection period, minimum flows are determined by required salmon incubation flows.

Table 3.5-7. Fry protection at Newhalem gage.

Month	Minimum Sufficient Instantaneous Flow (cfs)[1]
January	[2]
February	1,800
March	1,800
April	1,800
May	1,500
June	1,500
July	1,500
August	2,000
September	1,500
October	1,500
November	[2]
December	[2]

1 Minimum flow may be reduced to 1,500 cfs when natural flow on the inflow day is less than 2,300 cfs (Section 6.3.3.2 (3) of the Revised FSA).

2 Minimum flows in these months are determined by incubation flow requirements.

3.5.2.5 Steelhead and Chinook Salmon Yearling Protection

To protect steelhead and Chinook Salmon yearlings from stranding and to minimize local displacement from foraging habitats down-ramp rates are limited to < 3,000 cfs/hr from October 16 to January 31 each year.

3.5.2.6 Other Flow Management Measures

The Revised FSA Flow Plan recognizes that some impact to anadromous fish spawning, incubation, and rearing may occur notwithstanding the protection measures described above, particularly when uncontrollable flow events occur (City Light 2011). In addition to the downstream flow requirements, it was recognized that specific voluntary actions may be needed to better protect salmon and steelhead spawning areas, redds, and fry as a result of new information on the effects of flows on spawning, incubation, and fry survival. These voluntary actions are cooperatively developed through the FCC, which considers Project system flexibility, economic ramifications, and potential effects to all anadromous species and life stages at a given time. Critical data considered include tributary inflows between Newhalem and Marblemount and field monitoring of redd locations. Implementation of voluntary actions typically involves development of a proposed action by City Light during or at the end of the spawning season for each species (or spawning group in the case of steelhead) and whenever uncontrollable flow events occur during the spawning, incubation, and rearing periods. The proposal is then presented to the FCC for review and discussion to reach consensus on a plan of action.

3.5.2.7 Water Supply

City Light is not a water supply utility and the Skagit River Project is not used for this purpose. Domestic water for the townsites and Gorge and Diablo powerhouses is supplied by wells. A tap off the penstock provides domestic water for Ross Powerhouse.

3.5.3 Project Capacity, Production, and Outflow Records

3.5.3.1 Dependable Capacity

Based on the North American Reliability Council's (NERC) 2018 report on generator availability, the Skagit River Project's dependable capacity is 803.7 MW.

3.5.3.2 Energy Production/Generation

In March 2020, City Light filed an updated Exhibit M to reflect increased generation capabilities and capacities resulting from turbine and generator upgrades at the three developments during the Project license term. Upon approval by FERC, the increased authorized installed capacity will be approximately 805 MW, and the generation capability is nearly 840 MW (Table 3.4-1). The previous Exhibit M listed the total authorized installed capacity of 650.25 MW (FERC 1997). The three Project powerhouses have four generators each, with capacities that currently range from 1.2 MW for the small house units at the Diablo Development to 112.5 MW for the units at the Ross Development (see Table 3.4-1). Generators were rewound at the Gorge Development in 1982, 1983, and 1990; at the Diablo Development in 2017 and 2018; and at the Ross Development in 2006, 2007, 2008, and 2010. Transformers at Ross Powerhouse were replaced in 2016 and 2017. The rewinds at Diablo and the new transformers at Ross resolved previous equipment-related limitations on generating capacity at these powerhouses.

The average annual energy production from the Skagit River Project over the past five years (2014-2018) is approximately 2,503,955 MWh, with a variation of 449,002 MWh between the highest and lowest year (Table 3.5-8). Average monthly generation ranged from a low of 188,594 MWh in 2018, to a high of 226,011 MWh in 2014.

Table 3.5-8. Skagit River Project annual and monthly average energy production (2014-2018).

	2014	2015	2016	2017	2018	5-Year Average
Total Annual MWh	2,712,135	2,413,340	2,698,171	2,432,997	2,263,133	2,503,955
Monthly Average MWh	226,011	201,112	224,848	202,750	188,594	208,663

Monthly generation for each of the developments over the 2014-2018 period is summarized in Table 3.5-9. Energy production at the Project varies greatly over any given year but usually peaks during the winter months, when inflow and energy needs are high, and is the lowest in late summer (Figure 3.5-4).

Table 3.5-9. Skagit River Project generation (MWh) per generation year (January – December; 2014-2018).

	2014			2015			2016			2017			2018			Average Monthly		
Month	**Gorge**	**Diablo**	**Ross**	**Gorge**	**Diablo**	**Ross**	**Gorge**	**Diablo**	**Ross**	**Gorge**	**Diablo**	**Ross**	**Gorge**	**Diablo**	**Ross**	**Gorge**	**Diablo**	**Ross**
Jan	78,731	63,883	58,234	114,779	101,625	97,887	116,459	104,174	105,878	96,784	87,264	89,625	105,097	56,314	89,950	102,370	82,652	88,315
Feb	75,421	63,969	60,957	108,664	97,267	96,934	105,020	92,044	85,165	59,520	44,911	34,341	112,698	50,689	124,516	92,265	69,776	80,383
March	89,533	71,641	56,459	97,682	82,708	78,835	108,884	97,315	93,762	78,956	67,965	57,653	100,018	59,438	106,295	95,015	75,813	78,601
April	90,834	76,811	62,351	69,737	55,768	49,652	82,997	64,836	46,315	90,003	57,222	66,426	65,830	50,344	27,211	79,880	60,996	50,391
May	88,381	58,629	41,514	56,725	40,854	22,544	71,659	75,390	58,762	105,159	51,181	58,687	71,091	30,572	15,860	78,603	51,325	39,473
June	108,508	86,785	94,217	64,007	49,132	32,798	82,802	67,249	51,396	109,343	59,452	86,338	70,889	38,124	31,469	87,110	60,148	59,244
July	117,391	98,721	108,885	61,216	47,917	31,956	76,866	62,570	47,771	88,034	60,269	57,616	71,347	55,018	34,368	82,971	64,899	56,119
Aug	64,950	53,565	34,656	39,722	21,427	9,846	54,739	42,436	32,968	58,914	46,862	33,344	35,116	48,928	32,804	50,688	42,644	28,724
Sept	67,622	54,373	45,496	72,744	57,991	55,591	70,259	58,750	60,234	65,158	52,481	55,184	73,766	56,362	58,809	69,910	55,991	55,063
Oct	74,018	55,707	46,849	78,359	62,263	63,224	93,147	67,023	67,746	72,808	57,973	52,001	81,124	61,090	61,310	79,891	60,811	58,226
Nov	101,989	86,375	82,169	87,603	69,274	62,620	87,627	62,086	67,030	84,926	47,154	64,175	80,237	57,513	48,321	88,476	64,480	64,863
Dec	100,487	87,298	104,726	102,390	88,799	82,800	86,081	76,343	74,388	89,071	60,094	86,103	79,787	61,735	59,093	91,563	74,854	81,422
Average Annual Monthly	88,155	71,480	66,376	79,469	64,585	57,057	86,378	72,518	65,951	83,223	57,736	61,791	78,917	52,177	57,501	83,228	63,699	61,735
Total Annual	1,057,865	857,757	796,513	953,628	775,025	684,687	1,036,540	870,216	791,415	998,676	692,828	741,493	947,000	626,127	690,006	998,742	764,391	740,823

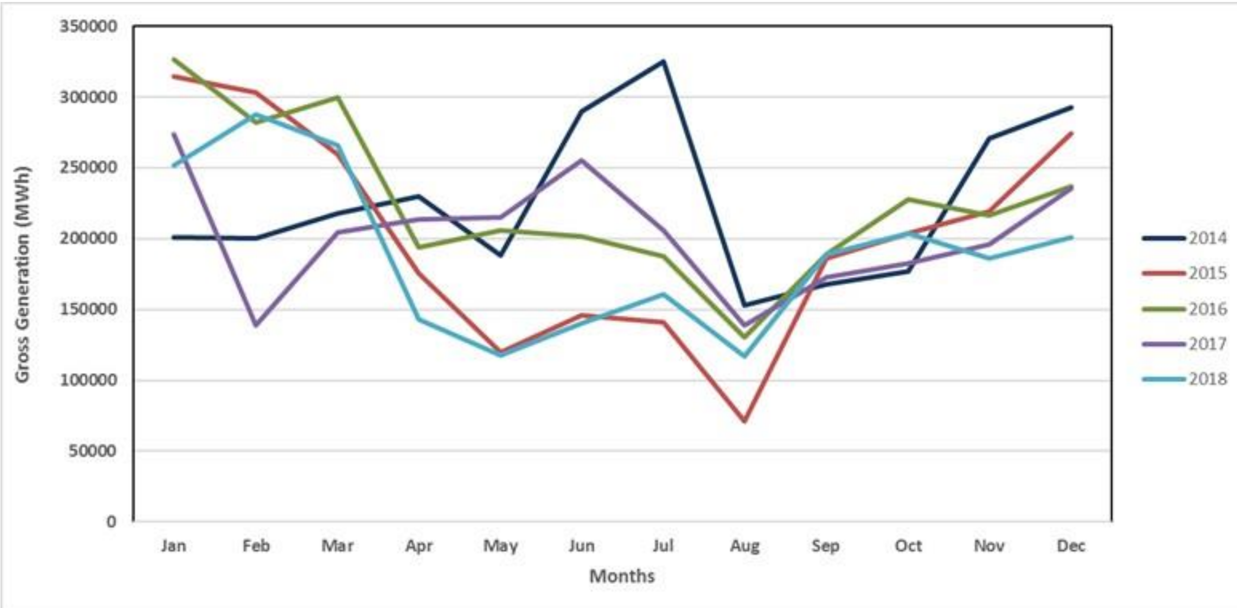

Figure 3.5-4. Average monthly generation for the Skagit River Project (2014-2018).

Of the three developments, the Gorge Development produces the greatest amount of energy and was responsible for 38-42 percent of the total Skagit River Project output from 2014-2018 (Figure 3.5-5). This is because Gorge Powerhouse generates constantly to maintain required minimum flows in the river downstream of the Project. Despite its larger capacity, generation at the Ross Development was less than the Diablo Development three of five years between 2014 and 2018. The Ross Development exceeded generation at the Diablo Development in 2017 and 2018 primarily because of turbine rewinds at the Diablo Development which reduced plant capacity in those years.

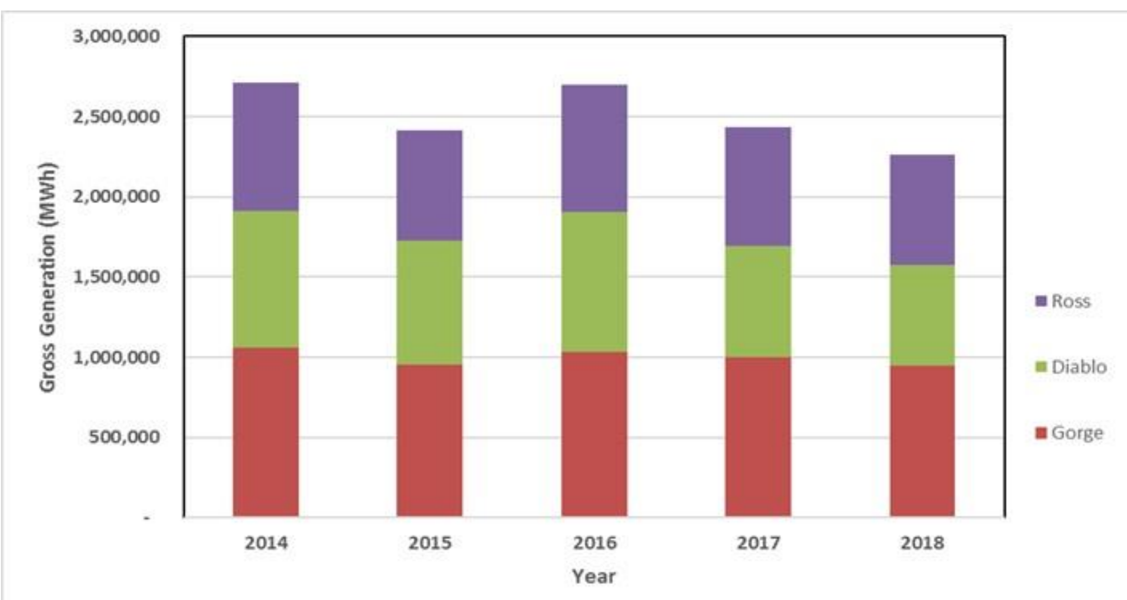

Figure 3.5-5. Average annual generation for the Skagit River Project by development (2014-2018).

3.5.3.3 Outflow

The sequential configuration of the Project and the distinct roles of the three reservoirs is illustrated by the outflow data (Tables 3.5-10 through 3.5-12). Average monthly discharge follows the same trend for each plant and reflects the generation data – with high outflow in the winter months and low in the late summer. Outflow from the Ross and Diablo developments is calculated from generation and spill data. Outflow from the Gorge Development is measured at the USGS stream gage in Newhalem, just downstream of the powerhouse.

Table 3.5-10. Monthly minimum, average, and maximum outflows (cfs) from Ross Lake (2014-2018).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2014	Maximum	4,054	5,193	4,460	4,851	4,237	8,701	8,587	3,583	3,620	4,181	9,331	11,434	11,434
	Average	3,219	3,745	3,312	3,842	2,498	4,663	5,121	1,866	2,419	2,354	4,179	5,144	3,526
	Minimum	2,051	2,593	743	3,016	715	1,861	1,766	516	1,225	935	43	2,696	43
2015	Maximum	6,772	6,997	6,619	3,565	2,464	3,846	2,814	1,305	4,030	4,312	5,919	5,240	6,997
	Average	4,935	5,340	4,092	2,740	1,290	1,798	1,664	583	2,773	3,106	3,145	4,227	2,959
	Minimum	685	559	1,343	1,823	61	440	554	0	410	1,089	908	1,057	0
2016	Maximum	7,329	6,374	6,558	4,326	5,491	5,254	4,207	2,512	4,131	5,694	9,886	6,598	9,886
	Average	5,429	4,821	5,053	2,779	3,069	2,812	2,443	1,731	2,957	3,390	3,618	4,100	3,515
	Minimum	939	439	3,729	138	1,009	329	783	703	1,398	275	938	2,596	138
2017	Maximum	7,315	3,681	6,783	4,917	5,552	9,040	4,414	3,086	4,500	4,255	9,719	11,706	11,706
	Average	4,940	2,473	3,545	4,010	3,525	4,686	3,019	1,869	2,864	2,826	3,701	4,712	3,519
	Minimum	2,150	450	1,105	2,660	562	2,368	1,808	744	1,009	608	702	2,708	450
2018	Maximum	5,945	11,591	13,269	2,572	3,011	3,507	3,490	3,396	4,085	4,666	4,097	3,978	13,269
	Average	4,904	7,391	6,496	1,918	1,226	2,139	1,993	1,911	3,347	3,550	2,936	3,346	3,407
	Minimum	3,584	3,859	2,303	987	166	742	518	905	844	1,722	430	2,347	166

Table 3.5-11. Monthly minimum, average, and maximum outflows (cfs) from Diablo Lake (2014-2018).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2014	Maximum	4,041	5,095	4,771	4,949	4,167	7,149	7,087	4,116	3,407	4,801	6,982	6,931	7,149
	Average	3,634	3,984	4,059	4,459	3,221	5,122	5,675	3,115	3,186	3,172	5,114	5,022	4,145
	Minimum	3,061	3,449	2,145	3,716	2,703	3,029	3,083	2,229	2,680	2,500	2,268	3,794	2,145
2015	Maximum	6,577	6,894	6,807	3,607	2,709	3,944	3,116	2,457	4,076	3,971	5,260	5,775	6,894
	Average	5,771	6,216	4,706	3,269	2,437	2,980	2,808	1,346	3,499	3,604	4,076	4,995	3,793
	Minimum	3,799	2,562	3,465	2,127	2,115	2,133	2,567	12	2,185	3,139	2,147	2,846	12
2016	Maximum	6,662	6,554	6,548	4,342	5,636	5,272	5,349	3,084	4,172	5,274	4,842	6,754	6,754
	Average	5,908	5,575	5,467	3,793	4,212	3,876	3,563	2,535	3,474	3,779	3,574	4,311	4,170
	Minimum	3,807	2,715	3,872	2,686	3,061	2,811	2,845	1,810	2,129	2,553	2,651	3,624	1,810

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	Maximum	6,948	3,813	6,803	3,574	3,569	8,838	5,794	3,931	4,183	4,771	9,131	12,456	12,456
	Average	5,042	2,892	3,875	3,369	2,918	5,500	4,240	2,817	3,326	3,399	4,422	4,918	3,899
	Minimum	2,477	1,932	782	2,934	24	3,420	3,100	1,577	1,384	2,747	2,767	3,565	24
2018	Maximum	6,235	10,401	11,160	3,285	4,136	3,667	4,737	3,998	3,914	3,957	4,741	3,953	11,160
	Average	5,198	7,205	6,466	2,903	2,794	3,056	3,149	2,715	3,553	3,665	3,488	3,537	3,959
	Minimum	3,714	5,080	3,514	2,549	1,676	2,294	2,027	1,812	1,535	2,858	2,335	3,224	1,535

Table 3.5-12. Monthly minimum, average, and maximum outflows (cfs) from Gorge Lake (2014-2018).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2014	Maximum	4,650	5,780	5,620	5,690	5,670	13,200	12,300	4,740	3,780	6,230	12,400	14,506	14,506
	Average	4,365	4,601	5,035	5,309	5,213	7,563	8,201	3,617	3,651	3,992	6,605	7,054	5,437
	Minimum	4,020	4,120	4,350	4,570	4,480	5,370	4,220	2,550	3,020	3,510	4,400	4,474	2,550
2015	Maximum	7,402	7,931	7,572	3,990	3,300	4,430	3,330	3,790	4,490	5,730	6,420	6,960	7,931
	Average	6,838	7,332	5,594	3,849	3,044	3,534	3,250	2,355	4,091	4,248	5,227	5,963	4,593
	Minimum	4,606	6,254	4,621	3,100	2,830	2,930	3,110	2,190	3,410	3,630	4,130	5,410	2,190
2016	Maximum	7,980	7,590	7,660	5,040	6,400	6,660	6,270	3,510	4,550	7,860	10,800	7,390	10,800
	Average	6,975	6,698	6,397	4,738	5,159	5,042	4,169	2,870	3,925	5,339	5,454	4,879	5,132
	Minimum	5,880	3,870	4,470	3,520	3,960	3,800	3,560	2,200	2,410	4,110	4,020	4,280	2,200
2017	Maximum	7,640	4,690	7,630	6,180	6,650	10,800	6,890	4,490	4,540	7,590	14,900	12,800	14,900
	Average	5,647	3,645	5,132	5,370	6,298	7,489	5,063	3,237	3,734	4,021	5,546	5,507	5,064
	Minimum	2,950	2,960	3,650	4,140	5,540	5,480	3,830	1,800	1,670	3,530	3,600	4,250	1,670
2018	Maximum	7,140	12,400	12,300	4,250	6,240	4,470	5,780	4,670	4,560	4,560	6,430	5,280	12,400
	Average	6,040	8,805	7,451	3,722	4,226	4,179	3,958	3,210	4,191	4,420	4,617	4,348	4,907
	Minimum	4,580	7,120	4,020	3,510	2,670	2,940	2,910	2,210	1,810	4,270	4,140	3,050	1,810

3.6 Other Project Information

3.6.1 Current License Requirements

The existing Project license consists of 21 articles related to generation operations, as well as measures for mitigating effects on natural and cultural resources. The articles included in the license, as modified by the 1996 Rehearing Order, are summarized in Table 3.6-1.

Table 3.6-1. Existing license articles for the Skagit River Project.

Article	Description
201[1]	Sets acreage for annual charges requiring reimbursement to the U.S. Treasury for Project occupancy, use, and enjoyment of federal lands.
202	Provides Licensee with the authority to grant permission for certain types of use and occupancy of Project lands and waters and to convey certain types of use and occupancy.
301	Establishes storage requirements and flood control operations for Ross Reservoir.
302	Requires compliance with requests for flood control operational changes by the Corps of Engineers.
303	Requires filing of Exhibits M, Project as-builts, with FERC within 90 days.
401	Requires filing of a Project Fishery Plan to minimize Project impacts on fish resources, including spawning ground and habitat within 180 days of license issuance.
402	As per FSA Section 2.4, required annual meeting of agencies, tribes, interested parties, and FERC staff to facilitate coordination of the license articles.
403	Fill Ross Lake as early and as full as possible after April 15 each year in accordance with FSA Section 4.1. Achieve full pool by July 31 each year and maintain through Labor Day weekend subject to adequate runoff, anadromous fish protection flows downstream of the Project, flood protection, spill minimization, and firm power generation needs.
404[1]	Provide flows for protecting anadromous fish resources in the mainstem river downstream of Gorge Powerhouse in accordance with FSA Section 6.0.
405	Release water from the Gorge Plant to provide suitable habitat conditions for salmon and steelhead in the river during years of season of exceptionally low flows in accordance with FSA Section 6.4. *Modified in rehearing to include the full definition of flow insufficiency and circumstances that limit City Light's ability to react or control flows as determined in FSA Sections 6.4 and 6.5.*
406	File Project power planning reports and scheduling procedures in accordance with FSA Section 6.6 with the Parties to the FSA. Report malfunctions of instruments affecting fish flow requirements for a period longer than 24 hours immediately to the FSA signatories and within 10 days to FERC. *Modified in rehearing to change FSA signatories to FCC signatories.*
407	Verify the Effective Spawning Habitat Model and the Temperature Unit Model in accordance with FSA Section 6.7.1; conduct compliance monitoring in accordance with FSA Section 6.7.3; and file semi-annual flow reports.
408	Develop measures to address residual impacts and habitat losses for fishery resources due to operation of the Project. Make available to the WDFW and tribes a maximum of $6,320,000 to implement non-flow measures at per FSA Section 7. File an annual report for each non-flow program. *Modified in rehearing to include USFS as a funding recipient.*
409	File a Project Soil Erosion Control Plan with FERC within 180 days of license issuance. Plan is to implement provisions included in the Settlement Agreement concerning erosion control and the Erosion Control Plan filed on April 30, 1991, for 37 project-related recreation sites and 18 project-related roads. *Modified in rehearing to correct a typo (Erosion Control Plan instead of Recreation Plan).*

Article	Description
410	File a plan within 180 days of license issuance that implements those portions of the Settlement Agreement concerning wildlife and the Wildlife Habitat Protection and Management Plan filed on April 30, 1991. *Modified on rehearing to include all elements of the WSA (payments to NPS for wildlife monitoring; payments to NCI for wildlife education programming at the ELC; payments to USFS for bald eagle monitoring; and funds for land acquisition)*.
411	File a Project Aviation Marker Plan with FERC within 180 days of license issuance to install powerline identifiers to protect bald eagles at the Project. *Modified at rehearing to include USFS as a reviewer of the Marker Plan*.
412	File a Project Recreation Plan with FERC within 180 days of license issuance implementing provisions for continuing, mitigative, and enhancement measures as included in Sections 3.3, 3.4, and 3.5 of the Settlement Agreement on Recreation and Aesthetics. *Modified in rehearing to incorporate all enhancement measures included in Section 3.5 of the Settlement Agreement on Recreation Resources.*
413	File a Project Visual Quality Plan with FERC within 180 days of license issuance implementing provisions in Section 4.2 of the Settlement Agreement on Recreation and Aesthetics and the Report on Aesthetics. *Modified in rehearing to exclude development of a new greenhouse for the Project and to include vegetation management prescriptions as one way to manage visual quality along Projects' rights-of way*.
414	Implement provisions of the Memorandum of Agreement (MOA) By and Among FERC, Washington SHPO, Advisory Council on Historic Preservation (ACHP); U.S. Federally-recognized Sauk-Suiattle Tribe, Swinomish Tribal Community, and Upper Skagit Tribe; the Nlaka'pamux Nation; and City of Seattle regarding the Skagit River Hydroelectric Project. Provide $1,817,000 to the three U.S. tribes and the Nlaka'pamux Nation as per the Settlement Agreements with these parties. *Modified in rehearing to require that City Light file a plan for FERC approval to provide the funds to the tribes and First Nation.*
415	File an Annual Project Expenditures Plan for FERC approval on or before October 1 of each year that shows the amount of funding provided for expenditures under the license for the following year. File an annual Project Expenditures Statement with FERC by April 1 reporting funds expended under the License for the previous year.
416	Provide revised Exhibits F and K within 90 days of license issuance for FERC approval; include acreage of federal lands within the Project boundary and any off-site Project islands. *Modified in rehearing to require that City Light include all off-site Project islands as referenced in Articles 410 and 412 and as shown on Figure 3-1 of the Settlement Agreement on Recreation and Aesthetics.*

1 Article revised by the 2013 Order Amending the License and Revising Annual Charges for Project 553 (FERC 2013).

On July 12, 2011, City Light filed an application for a non-capacity amendment to the Project license (City Light 2011) to:

- Construct a second power tunnel between Gorge Dam and Gorge Powerhouse.
- Incorporate four modified flow measures to better protect downstream fisheries that City Light

had been voluntarily implementing since 1995.

- Adjust a small section of the Skagit River Project Boundary at Gorge Powerhouse and another near the intake at Gorge Dam.

As part of the amendment process City Light decided to update the 1991 FSA to include the voluntary flow measures described in Section 3.5.2 of this PAD. In addition, FERC's proposed issuance of a license amendment triggered consultation under Section 7 of the ESA between FERC and both NMFS and USFWS. Between the time of the original license in 1995 and the application for an amendment, three fish species found in the Skagit River and/or the Project reservoirs had been federally listed as threatened (i.e., Chinook Salmon, steelhead, and Bull Trout), as had one mammal species (i.e., Canada lynx). NMFS issued its Biological Opinion for Chinook salmon and steelhead on November 21, 2012, and USFWS issued its Biological Opinion for Bull Trout on February 12, 2013. Both Biological Opinions concluded that continued operation of the Project as proposed was not likely to jeopardize listed species or designated critical habitat. The USFWS issued a letter on December 30, 2011 concurring with FERC that Project operations would have no effect on federally listed wildlife species.

On July 13, 2013, FERC issued an Order Amending the License and Revising Annual Charges for Project 553 (FERC 2013). Most of the provisions in the 2013 Amendment related to construction of the Gorge second tunnel and defined the plans and submittals required prior to and after the construction process. To date, this project has not been undertaken for economic reasons. In addition to provisions regarding the Gorge second tunnel, there were several other significant changes and additions made to the 1995 Project license through the license amendment process. These are summarized below:

- Changed the Gorge facilities to include two power tunnels.
- Added the reasonable and prudent measure and terms and conditions of the Biological Opinion filed on November 21, 2012, and supplemented on March 1, 2013, by NMFS.
- Added the reasonable and prudent measure and terms and conditions of the Biological Opinion filed by USFWS on February 12, 2013.
- Revised Article 404 of the 1995 license to incorporate the four voluntary downstream fish protection measures, as provided by Section 6.0 of the Revised FSA.
- Required that the Project Fishery Resources Plan be revised to incorporate the provisions of the Revised FSA (2011) and filed with FERC within 90 days.

3.6.2 Additional FERC Orders

While there have been multiple FERC Orders regarding the Project since 1995, none but the 2013 Order Amending the License have involved significant changes. Several FERC Orders were issued to approve resource management and monitoring plans developed post-license (Table 3.6-2). The majority, however, were orders accepting and approving various license-required submittals, primarily annual expenditure statements and plans and resource reports (on a semi-annual, annual, bi-annual, and five-year basis, depending on the resource program).

Over the years, there have been several changes to the management and implementation plans developed for the Project license (Table 3.6-2). Several projects included in the original Recreation

Resources Management Plan, for example, were deemed infeasible or not necessary by NPS or USFS as recreational uses shifted over time. With FERC notification and/or approval, funding was reallocated to other projects identified by the agencies as high priority needs and comparable in scope and budget to projects in the original management plan. Similarly, some funds for the steelhead program in the FSA were shifted to the Chinook program in 2002 with the approval of the Non-Flow Coordinating Committee (NCC) and a notification letter to FERC (March 7, 2002).

In March 2020, City Light submitted a request to FERC for a license amendment to replace the existing fueling facility on Diablo. The submittal included the required environmental documentation and consultation record. The License Order is currently pending.

Table 3.6-2. Post-license FERC Orders related to resource management for the Skagit River Project.

Date	FERC Order/Receipt
01/22/1996	Order Approving Bald Eagle Monitoring Plan
04/02/1996	Order Modifying and Approving Wildlife Resources Management Plan
05/15/1996	Order Modifying and Approving Soil Erosion Control Plan
07/30/1996	Order Modifying and Approving Fishery Resources Plan
11/19/1996	Order Approving an Interim Recreation Resources Management Plan
12/10/1996	Order Approving Visual Quality Plan
03/18/1997	Order Amending Approved Soil Erosion Control Plan
03/27/1997	Order Approving Amended Wildlife Resources Plan
07/23/1997	Order Approving Revised Exhibit M and Revising Annual Charges
10/23/1997	Order Amending Recreation Resources Management Plan
07/06/1998	Order Amending Approved Soil Erosion Control Plan
07/13/1998	Order Approving Aviation Marker Plan
03/28/2008	Order Amending Recreation Resources Management Plan
06/07/2011	Receipt of Filing an Archaeological Resources Mitigation and Management Plan (ARMMP) for the Upper Skagit River Valley Archaeological District (confidential document; no Order on file with FERC eLibrary)
02/05/2014	Receipt of Filing an Amended ARMMP for the Upper Skagit River Valley Archaeological District (confidential document; no Order on file with FERC eLibrary)
04/24/2014	Order Approving Revised Fisheries Resources Plan (per 2013 Amendment)
07/14/2014	Order Modifying and Approving Puget Sound Chinook Salmon and Steelhead Monitoring Plan (per 2013 License Amendment)
10/17/2018	Order Amending Recreation Resources Management Plan

3.6.3 Compliance History

City Light is aware of no compliance violations or recurring non-compliance incidents under the current Project license. City Light has self-reported to FERC, agencies, and tribes the following deviations from license conditions:

- August 19, 1997 – Lower than minimum flows, excessive down ramping, and amplitude fluctuations. This incident occurred during a transition from planned spill to generation at

Gorge Development that was complicated by difficulties loading Unit 24. Formal letter report to the agencies, tribes, and FERC on August 29, 1997, followed by After-Action Report on September 9, 1997 that detailed future preventative actions.

- August 10, 2013 – Dewatering event downstream of Gorge Powerhouse. This event occurred during a severe and prolonged lightning storm that disabled all communications and control systems at Gorge Powerhouse, caused the generators to shut down, and damaged the USGS stream gage at Newhalem. It is believed that flow was completely interrupted at the powerhouse and fell far below the required August minimum of 2,000 cfs for at least 90 minutes. This incident, well outside City Light's control, was formally reported to FERC, agencies, and tribes on August 16, 2013; an After-Action Report was filed on September 26, 2013.
- There have been two years (2015 and 2019) when City Light has been unable to fill Ross Lake by July 31 and maintain normal maximum water surface elevation through Labor Day. These events were due to inadequate runoff and the need to maintain anadromous fish protection flows downstream of the Project. The license allows for low water surface elevation under these circumstances, among others. City Light informed FERC and worked with NPS to mitigate impacts on recreation.

A review of compliance with the license articles and associated Settlement Agreement elements is provided in Table 3.6-3.

Table 3.6-3. License compliance summary.

Article	Article Summary and Compliance Status
201	Pay annual fees. Ongoing – Paid annually.
202	Grant permission for certain types of use and occupancy of Project lands and waters and to convey certain types of use and occupancy. Continuing – Occurs rarely as Project is nearly all on federal land.
301	Maintain storage requirements and flood control operations for Ross Reservoir. Ongoing – Meet annual flood control storage of 60,000 acre-feet by November 15 and 120,000 acre-feet by December 1.
302	Comply with requests for flood control operational changes by USACE. Ongoing – Upon request.
303	File Exhibit M, Project as-builts, with FERC within 90 days. Complete – Filed as scheduled (see FERC Order, July 23, 1997).[1]
401	File a Project Fishery Plan within 180 days of license issuance. Complete – Filed as scheduled (see FERC Order, July 30, 1996) and revised in 2014 (see FERC Order, April 24, 2014).

Article	Article Summary and Compliance Status
402	Hold an annual meeting of agencies, tribes, interested parties, and FERC staff. Ongoing – Annual meetings of agencies, tribes, and interested parties took place through 2004. FERC staff did not participate and agency/tribal involvement was limited. Beginning in 2005, meetings are held at least annually with interested agencies and tribes for the fisheries, wildlife, and cultural resources programs. Coordination, but not formal meetings, occurs annually with NPS and USFS for the recreation program and with NPS for the erosion program.
403	Fill Ross Lake as early and as full as possible after April 15; achieve full pool by July 31 and maintain through Labor Day. Ongoing – Ross typically fills in early July. Unable to maintain pool in 2015 and fill in 2019 due to inadequate run off and fish protection requirements.
404[2]	Maintain flows for protecting anadromous fish resources in the mainstem river downstream of Gorge Powerhouse. Ongoing – Monitoring, tracking, and compliance.
405	Release water from the Gorge Plant to provide suitable habitat conditions for salmon and steelhead in the river during years of season of exceptionally low flows. Ongoing – When needed.
406	File Project power planning reports and scheduling procedures. Report malfunctions of instruments affecting fish flow requirements for a period longer than 24 hours immediately to the FSA signatories and within 10 days to FERC. Ongoing – Power planning and scheduling reports supplied monthly to the fisheries agencies and tribes. Instrument malfunctions reported as needed.
407	Verify the Effective Spawning Habitat Model and the Temperature Unit; conduct compliance monitoring; and file semi-annual flow reports. Complete – Effective Spawning Habitat Model and temperature unit verification. Ongoing – Compliance monitoring and semi-annual flow reporting ongoing.
408	Implement non-flow measures identified in FSA Section 7 to address residual impacts and habitat losses for fishery resources due to operation of the Project. File an annual report for each non-flow program. Complete – Off-channel chum habitat development; Newhalem and County Line ponds habitat improvements; and sediment reduction in tributaries to Skagit and Sauk rivers. Ongoing – Chinook research; off-channel habitat maintenance; resident trout production; tributary barrier removal; and annual reporting. Steelhead smolt production funds reprogrammed, with NCC approval, to steelhead and Chinook research (letter to FERC March 7, 2002).
409	File a Project Soil Erosion Control Plan with FERC within 180 days of license issuance. Implement plan for 37 project-related recreation sites and 18 project-related roads. Complete – Erosion Control Plan filed as scheduled (see FERC Order, May 15, 1996) and amended in 1997 and 1998. Erosion control at the originally identified sites. Ongoing – Erosion control measures at newly identified project-related recreation sites and roads; plant propagation; seed collection and greenhouse maintenance; and erosion site monitoring.

Article	Article Summary and Compliance Status
410	File a Wildlife Habitat Protection and Management Plan within180 days of license issuance and implement mitigation and enactment measures. Complete – Wildlife Habitat Protection and Management Plan filed as scheduled (see FERC Order, April 2, 1996) and amended in 1997. Conversion of City Light building in Newhalem to NPS Wildlife Research Center (1999); greenhouse construction (constructed in Marblemount by NPS with City Light funds); and wildlife lands acquisition. Ongoing – Payments to NCI for wildlife education; annual wildlife research grants; payments to NPS for annual wildlife monitoring in RLNRA; payments to USFS for bald eagle inventory and planning in the Wild and Scenic River corridor; wildlife habitat enhancement and restoration; and cultural resource evaluation as needed.
411	File a Project Aviation Marker Plan with FERC within 180 days of license issuance to install powerline` identifiers to protect bald eagles at the Project. Complete – Filed as scheduled (see FERC Order, July 13, 1998). Transmission line markers installed at Corkindale Creek crossing in 1999; monitoring finished in 2001.
412	File a Project Recreation Plan with FERC within180 days of license issuance and implement continuing, mitigative, and enhancement measures. Complete – Filed as scheduled (see FERC Order, November 19, 1996). Amended in 1997, 2008, and 2018. *NCI* – ELC design, construction, landscaping, furnishings, start-up; trail development, landscaping, and endowment (1996-2006). *NPS* – ADA-accessible fishing facility (2003); Colonial Creek boat ramp (2004); Damnation Creek boat-in picnic facility (2000); Desolation-Hozomeen Trail (Alternatives); Goodell raft access (1999); Gorge Creek Overlook (1999); Gorge Lake boat ramp (2007); Happy Flats Panther Creek Trail (2005); Hozomeen boat ramp (2001); Hozomeen water distribution system (2001); renovation of Ross Lake shoreline campgrounds and docks (2007); Thunder Knob Trail (2001); ELC plant propagation (2006); interpretive signage at various overlooks and trailheads; future needs assessment funding as per license. *USFS* – Black Peak Overlook Alternatives (reprogrammed to upgrade trailhead facilities along SR 20 in Okanogan and Wenatchee National Forest (2010); Lower Sauk Boat Access Site (2006); Marblemount Boat Access (2000); Skagit River Trail (aka Rockport State Park ADA Trail (2008); Sauk-Suiattle River Boat Access (2002); Copper Creek boat ramp (2009); various other capital improvement projects (i.e. Old Sauk River Trail) and interpretive signage design/installation projects; future needs assessment funding as per license. *City Light* – Bicycle facilities needs assessment (2003); Newhalem Visitor Contact Station (aka Skagit Information Center) construction (2002); Colonial Creek Campground electric supply cable replacement; ELC construction (2006). Ongoing – Funding for vehicles, wildlife programming, electricity and O&M at the ELC; various interpretive and capital projects for NPS and USFS as identified in the Settlement Agreement and subsequent modifications to the Recreation Resources Management Plan; O&M at NPS facilities within RLNRA and USFS facilities along the Skagit Wild and Scenic River and SR 20; Skagit Tours; annual contributions to the Skagit Environmental Endowment Commission (SEEC); Diablo Lake ferry service; Newhalem Playground and picnic facility maintenance.

Article	Article Summary and Compliance Status
413	File a Project Visual Quality Plan with FERC within 180 days of license issuance and implement provisions of the Settlement Agreement on Recreation and Aesthetics and the Report on Aesthetics. Complete – Filed as scheduled (see FERC Order, December 10, 1996). Landscape improvements and painting in Newhalem and Diablo; vegetation plantings for screening seven target sites in the transmission line ROW identified in the Settlement Agreement; Gorge Dam access bridge painting (1997); Diablo surge tank painting (2001); Ross Dam broome gate painting (2005); removal of Diablo Person Lift (2000); shielding of exterior lights; removal of three storage buildings in Newhalem; replacement of roofs and siding with more visually compatible materials. Ongoing – Maintenance of screening vegetation in the seven target sites within RLNRA; maintenance of vegetation in the transmission line ROW on City Light, state and federal lands according to the prescriptions in the Transmission ROW Vegetation Management Plan as modified to meet current NERC standards; consultation with NPS on appearance of new facilities and major maintenance projects. Incomplete – Transmission tower painting (to be done as part of routine maintenance); paving of the RV parking lot in Newhalem and the lot across the river from Gorge Powerhouse; vegetation screening of the maintenance yard in Newhalem; four landscape improvement projects in Diablo associated with Skagit Tour facilities (no longer relevant due to the relocation of tours).
414	Implement provisions of the MOA By and Among FERC, Washington SHPO, ACHP, Sauk-Suiattle Tribe, Swinomish Tribal Community, and Upper Skagit Tribe, Nlaka'pamux Nation, and City of Seattle regarding the Skagit River Hydroelectric Project. Provide $1,817,000 to the three U.S. tribes and the Nlaka'pamux Nation as per the Settlement Agreements with these parties. The MOA requires that City Light fulfill the terms of the Settlement Agreement for Cultural Resources. Complete – All payments to the tribes and Nlaka'pamux Nation as per the Settlement Agreements. Accomplishments under the Settlement Agreement for Cultural Resources include: development of an ARMMP for the Ross Lake National Archaeological District, a Historic Resources Mitigation and Management Plan (HRMMP), Newhalem Walking Tour brochure, Historic Structures Report for Gorge Inn and Cambridge House, an interpretive exhibit assessment, Skagit Maintenance Guidelines, and a computerized system for historic resources record keeping. Other completed measures: survey and testing in the Ross Lake drawdown area, Historic American Building Survey (HABS)/ HAER documentation and publication, historic photograph conservation, an inventory of trees in the Newhalem Historic District and maintenance guidelines, an update to the National Historic Register (NHR 2010). Ongoing – Implementation of the provisions in the MOA between FERC, Washington SHPO, ACHP, tribes, and Nlaka'pamux Nation and the ARMMP on protection of cultural resources; ongoing maintenance and revitalization of interpretive exhibits; and updates to the Newhalem Walking Tour brochure as needed. Next update to the NHR is scheduled for 2020.
415	File an Annual Project Expenditures Plan for FERC approval on or before October 1 of each year that shows the amount of funding provided for expenditures under the license for the following year. File an annual Project Expenditures Statement with FERC by April 1 reporting funds expended under the License for the previous year. Ongoing – On an annual basis.
416	Provide revised Exhibits F and K within 90 days of license issuance for FERC approval; include acreage of federal lands within the Project boundary and any off-site Project islands. FERC eLibrary indicates that City Light responded to requirements of License Article 416 on September 24, 1996.

1 City Light filed a revised Exhibit M in March 2020, and is awaiting approval by FERC.

2 Article revised by the 2013 Order Amending the License and Revising Annual Charges (FERC 2013).

As incorporated into the license by reference to the Settlement Agreement, City Light is required to submit periodic reports on implementation progress for the various resource programs (Table 3.6-4). These have been filed with the FERC and provided to the settlement agreement parties. In addition, as required by CFR 18 § 18, City Light submitted Form 80 reports for Project recreation facilities in 1997, 2003, 2009, and 2015.

Table 3.6-4. Resource program reporting requirements.

License Article	Report	Frequency and Due Date	
407	Flow Compliance Report	Semi-annually	4/30, 10/31
408	Non-Flow Program Report	Annually	7/15
409	Erosion Control Report	Every 2 years	5/15
410	Wildlife Report	Annually for 5 years, then every 5 years thereafter	4/31
411	Eagle/Transmission Line Action Plan	Complete, no further submittals	
414	Archaeological Report	Every 2 years for 10 years, then every 5 years thereafter	5/15
414	Historical Report	Every 2 years for 10 years, then every 5 years thereafter	5/15

FERC's regional office conducts an annual operations inspection, and Part 12 Independent Consultant Safety Inspections have been conducted every five years (last one completed in 2017). Other FERC inspections have been conducted in response to specific, unique events, such as the 2010 landslide that blocked the road required to access Ross Dam from the powerhouse.

FERC compliance inspections occurred in 2005, 2012, and 2019. The 2005 inspection did not identify any required corrective actions. The only item needing corrective action from the 2012 inspection was the absence of Part 8 signs for the Project. City Light subsequently installed signs at two sites – at the Skagit Information Center in Newhalem and at the tour dock on Diablo Lake. Following the 2019 inspection, FERC provided a letter (dated September 18, 2019) listing eight items needing corrective action. City Light responded by letter on October 17, 2019 with documentation of the actions taken to correct two of the eight items and requesting additional time to develop the plans and schedules needed to address the other six. As of January 1, 2020, City Light had at least partially addressed all but two of the action items from the 2019 inspection (Table 3.6-5).

Table 3.6-5. Action items from 2019 FERC environmental compliance inspection and schedule to address.

Action Items Identified in 2019 FERC Inspection	City Light Submittal to FERC or Extension Request
Provide description of any land acquisitions/exchanges that have occurred over the term of the license	Submitted description and maps 11/17/19
Repair or replace the Newhalem gauge	Replaced gage on 8/23/2019; submitted documentation 10/17/19
Provide a plan and schedule to update signage on access road to upper end of inclined lift	Completed 10/16/2019; submitted documentation 10/17/19
Provide a plan and schedule to update Part 8 signage and consider additional sign locations	Requested 120-day extension for submittal by 03/16/20
Provide a status report of the 17 measures included in the Visual Quality Plan and a plan and schedule to address any incomplete measures	Requested 120-day extension for submittal by 03/16/20
Provide a detailed description of emergency response and feasibility assessment of secondary containment for hydraulic hoists at Ross Dam Intake Gate House	Completed description of emergency response and submitted 11/17/19; requested 240-day extension for feasibility assessment for submittal by 06/14/20
Provide a detailed description of emergency response and feasibility assessment of secondary containment for the hydraulic hoists at Gorge Dam Power Intake Building	Completed description of emergency response and submitted 11/17/19; requested 240-day extension for feasibility assessment for submittal by 06/14/20
Provide a plan and schedule to empty and remove the two Hozomeen fuel storage tanks	Removed tanks on 10/31/19; submitted documentation 11/17/19

3.6.4 Net Investment

City Light is a municipal utility in Washington State and a municipality within the meaning of Section 3(7) of the Federal Power Act (FPA). Because City Light is a state subdivision, the Project is not subject to the takeover provisions of Section 14 of the FPA. Accordingly, the Commission's regulations do not require City Light to include an estimate of takeover costs. However, to address the requirements of FERC's PAD regulations, City Light provides net investment values below.

The net investment in the Skagit River Project as of December 31, 2018, was $218,758,342, based on original construction and past improvements, minus accumulated depreciation (Table 3.6-6).

Table 3.6-6. Net investment for each Skagit River Project development (as of December 31, 2018).

Development	Net Investment Value
Ross	$76,103,021
Diablo	$86,318,880
Gorge	$56,336,441
Total	$218,758,342

Costs associated with implementing the current Project license were estimated at $18,455,525 net of additions/depreciation, as of December 31, 2018.

3.6.5 Statement Regarding Benefits under Section 210 of PURPA

City Light is not seeking benefits under Section 210 of PURPA for the Skagit River Hydroelectric Project.

3.7 Proposed Operations and Facilities

Like all energy infrastructure facilities, the Project requires routine maintenance, much of which is performed annually or more often. Other maintenance activities and repairs, while routine, are needed only periodically. A small subset of maintenance work involves occasional but significant rehabilitation or replacement of aging or deteriorating facilities or equipment, sometimes only once over a license period. In addition, City Light is also considering several modifications to Project facilities and associated operations over the next license.

3.7.1 Routine Maintenance Activities

Annual and periodic routine maintenance activities expected to continue over the next license period include but are not limited to the following.

- Maintenance at the dams, including patching and repairing concrete; painting, maintaining, retrofitting and repairing spill gates, valves and other structures; clearing debris from intakes; and removing trees from the sides and bases of dams.
- Road and parking area maintenance (regrading, filling potholes, repaving) and snow removal.
- Maintenance of marine vessels, facilities, and bridges (painting, structural, and other repairs).
- Maintenance of buildings and other structures (roofing, painting, repairs), including the ELC, houses in Newhalem and Diablo, and historic displays.
- Landscaping in Diablo and Newhalem and maintenance of associated trails and native habitats (weeding, replanting, hazard tree removal, and fuels reduction).
- Maintenance, repair, and replacement of interpretive, way-finding, and public safety signage.
- Water and sewer system maintenance, including the septic system at Diablo and the Newhalem Wastewater Treatment Plant (water towers, pumphouses, wells, below grade pipes and structures, outfalls).
- Maintenance and repair of distribution poles, underground duct banks and cables and transmission towers and lines.
- Maintenance of powerhouse equipment such as generator powertrains, transformers, and other plant elements.
- Occasional rock scaling and stabilization of cliffs/steep slopes as needed to prevent damage to the powerhouses, dams, water conveyance systems, roadways, and other equipment and facilities.
- Periodic dredging in Project reservoirs to maintain access to marine facilities and tailwater capacity at powerhouses.
- Management of reservoir wood – Logs, rootwads, and woody debris enter all Project reservoirs, primarily from tributaries but occasionally from shoreline erosion. Woody debris is

passed from Gorge Lake downstream via a log chute at the dam. Floating wood on Diablo Lake is collected throughout the year, temporarily stored at Buster Brown Cove, towed to a collection point near the mouth of Sourdough Creek, and extracted. It is then transported via dump truck to the Aggregate Storage Facility, then moved into the Skagit River from October through April. Similarly, wood floating on Ross Lake is collected each summer and moved to various storage areas until it can be towed to a collection point near Ross Dam. From there it is loaded into a dump truck, transported down the Ross Haul Road, barged across Diablo Lake and taken to the Aggregate Storage Facility. See Section 3.5.1 of this PAD for further details.

- Management of powerline vegetation – Vegetation management in the transmission line ROW is conducted by two crews. The Newhalem crew works from the south of the Sauk River crossing, north to Ross Lake. The Bothell crew works from the Sauk River, south to the Bothell Substation. Vegetation management in both portions of the ROW is performed year-round. Vegetation management practices are compliant with City Light’s Transmission ROW Vegetation Management Plan (City Light 1990), and the NERC requirements. Throughout the transmission line corridor, the size and location of vegetation must meet NERC sag and sway clearance requirements and typically, vegetation is kept 25 feet, vertically and horizontally, away from the lines. See Section 4.6.4 of this PAD for further details.

3.7.2 One-time Major Maintenance/Upgrade/Replacement Projects

Hydroelectric facilities are designed and maintained to last for many years; nonetheless, every piece of equipment has a life cycle and eventually needs to be replaced or upgraded to meet new industry or safety standards. The transformers at Ross Powerhouse, for example, were installed in the 1950s and replaced in 2016. The replacement of major equipment and other large-scale maintenance/upgrade projects may occur only once over a license period but may require significant capital investments. These projects may also have impacts on Project operations, as well as potential cultural and environmental impacts that will be considered in the license application, as appropriate. One-time major maintenance and equipment replacement projects anticipated at the Skagit River Project include the following.

- **Diablo Powerhouse House Unit Replacement –** Two 1.2-MW house units in Diablo Powerhouse are nearing the end of their life cycle and will need to be replaced.
- **Diablo Dam Road Repairs –** The road from SR 20 to Diablo Boathouse will need some major maintenance work, including significant repair or replacement of the timber crib wall on the section between the highway and Diablo Dam.
- **Diablo Incline Lift Decommissioning –** The incline lift that runs up the side of the hill in the Reflector Bar section of Diablo has not operated in nearly 20 years. The facility needs to be decommissioned to address safety concerns with the counterweights and the structural integrity of the associated buildings.
- **Ross Dam Low-Level Outlet Upgrade –** The Ross Dam low-level outlet consists of two six-foot-diameter pipes leading to hollow jet valves that can be opened to evacuate the reservoir once water levels drop below the spill gates. The inlet to the pipes is on upstream side of the dam near the right abutment and consists of two eight-foot square broome gates. The pipes are embedded in concrete through the dam and then enter the tunnel originally used to divert the Skagit River during construction of the dam. The upstream end of the diversion tunnel is blocked with a concrete plug. The pipes run through the tunnel elevated on saddle walls to two

Howell Bunger valves at the downstream end; the centerline of the valves is 10 feet above the highest water level of Diablo Lake. An opening below the valve access platform, one foot below Diablo Lake high water, acts as a weir and lets water flow back into the tunnel. In the past, a sump and pump were used to dewater the tunnel for inspection and maintenance. However, a sample of the water from the tunnel has indicated the potential for low levels of lead contamination—most likely from maintenance work done on the pipes over 25 years ago. While the outlet remains operable, the pipes have not been inspected for approximately 20 years, which requires remediating the contamination so that the tunnel can be drained. For dam safety reasons the outlets need to be either decommissioned or properly inspected, tested, maintained, and upgraded, if needed.

Additional activities being considered for the next license term include:

- Diablo Spillway Bridge Repairs
- Ross Intake Bridge Retrofits
- Transformer Replacements
- Generator Rewinds and Turbine Runner Replacements
- Stabilization of the Blue Pool in Ladder Creek Gardens

Of these projects, replacement of the Diablo Powerhouse house units, repairs on the Diablo Dam Road, and decommissioning the incline lift are planned within the next 10 years, most likely after a new license is issued. The others will occur as needed and will be scheduled over the next license period. There may be additional one-time projects that have not been identified at this time.

3.7.3 Proposed New Project Facilities, Rehabilitation Activities, and Operational Changes

City Light is considering several new facilities and rehabilitation activities at the Skagit River Project. The environmental impacts associated with the proposals identified below would be analyzed during relicensing.

- **Diablo Tailwater Restoration –** The proposed project would involve the dredging of deposits that have accumulated in the main channel downstream of the confluence of Stetattle Creek. The project would restore hydraulic head and associated hydroelectric generating capacity at the Diablo Powerhouse which has been reduced by approximately three percent since Project construction due to the deposits from Stetattle Creek. The project would ideally eliminate the need to make significant changes to the powerhouse to restore access to the tailrace without the need to pump out water.
- **Diablo Lake Tour Dock –** This project would involve construction of a new tour dock on the shoreline of Diablo Lake near the ELC. The current tour dock is about one-half-mile from the check-in site for the Skagit Tours and requires that tour participants either walk along a narrow road or take a shuttle bus. A dock near the ELC would improve the tour experience for elderly and participants with disabilities by improving access and safety. The existing tour dock would be removed and the site repurposed or restored.
- **Pumped Storage at the Ross Development –** Pumped storage at the Ross Development would use energy during periods of low demand by utilizing the existing low-level outlet in Ross

Dam and new pumps to move water from Diablo Lake back up to Ross Lake. During periods of high energy demand, the pumped water stored in Ross Lake would again be used to generate electricity at Ross Powerhouse. Pumped storage at the Ross Development could benefit City Light, the regional power grid, and the Skagit River, particularly as the climate changes. For example, Ross Lake could be filled using winter inflows from rain to compensate for reduced snowmelt. This would help ensure available water during the summer for downstream flows. In addition, the increased operational flexibility at the Project would improve the ability to integrate increased renewable (wind and solar) and distributed energy sources into the regional grid.

The changes to Ross facilities needed to accommodate pumped storage would be relatively modest and would primarily entail the installation of new pumps directly below the existing low-level outlet, a single span of transmission line across the Project tailrace, and excavation at the bottom of Diablo Lake to provide sufficient submergence for the pumps. The low-level outlet in Ross Dam would be re-purposed to create a benefit for the grid and expansion for renewable resources. Pumped storage would result in operational changes, particularly at Ross Powerhouse, and both Ross and Diablo reservoirs would experience greater daily fluctuations.

City Light will conduct a preliminary engineering and economic feasibility analysis of pumped storage at Ross in 2020. Depending on the results of this preliminary analysis, a decision will be made on whether to include this project in the license application and initiate an assessment of environmental impacts.

The current Skagit River Project license includes a second power tunnel at the Gorge Development which has not yet been constructed. City Light will update the economic analysis using the market conditions projected over the next license period; results will be used to determine if the second tunnel should continue to be included as part of the Skagit River Project.

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4.0 DESCRIPTION OF EXISTING ENVIRONMENT AND RESOURCE EFFECTS

4.1 Overview

This section contains an overview of the Skagit River basin and subsections dedicated to the following resource areas: Geology and Soils, Water Resources, Fish and Aquatic Resources, Botanical Resources, Wildlife Resources, Recreation and Land Use, Aesthetic Resources, Cultural Resources, Tribal Resources, and Socioeconomic Resources. Each resource section contains a description of the existing environment, an account of potential Project-related effects, a description of the Project's contribution to cumulative effects as appropriate, and a description of existing and proposed PME measures. The organization of the existing environment descriptions varies as needed among resource areas to appropriately characterize the respective resources. For purposes of environmental analysis in this section, all fish and wildlife mitigation lands are included in the analysis, whether or not they are within the Project Boundary (per Figures 3.2-1 and 3.4-28) and are collectively referred to as "mitigation lands" or "fish and wildlife mitigation lands".

Citations for all sources used in the development of sections 4.2 through 4.12 are provided in the References section (Section 8.0) of this PAD. Appendices are provided when detailed information is needed to support the content in a given resource section, i.e., usually tables and figures that are too extensive to include in the body of the PAD.

4.2 River Basin Overview

The Project's generating facilities are located on the Skagit River in Whatcom County, although Ross Lake, the most upstream reservoir, crosses the U.S.-Canada border and extends about one mile into British Columbia. Power from the Project is transmitted via four powerlines that terminate north of Seattle. The transmission lines parallel the Skagit River to about RM 75 and also cross the Sauk, Stillaguamish, Snohomish, and Cedar-Sammamish watersheds. Project fish and wildlife mitigation lands are located in the Skagit, Sauk, and South Fork Nooksack watersheds. Towns along the Skagit River, from upstream to downstream, include Diablo and Newhalem, located in Whatcom County and Marblemount, Rockport, Concrete, Sedro-Woolley, and Mount Vernon located in Skagit County.

4.2.1 Description of Skagit River

The Skagit River, which is located primarily in the northwest corner of the State of Washington (Figure 4.2-1), is approximately 135 miles long, with a total drainage area of 3,115 sq. mi. (USACE 2013). The northern end of the basin extends about 28 miles into Canada, and about 381 sq. mi. of the total watershed area is located in British Columbia (USGS 2019). The headwaters of the Skagit River are at Allison Pass in the Canadian Cascades.

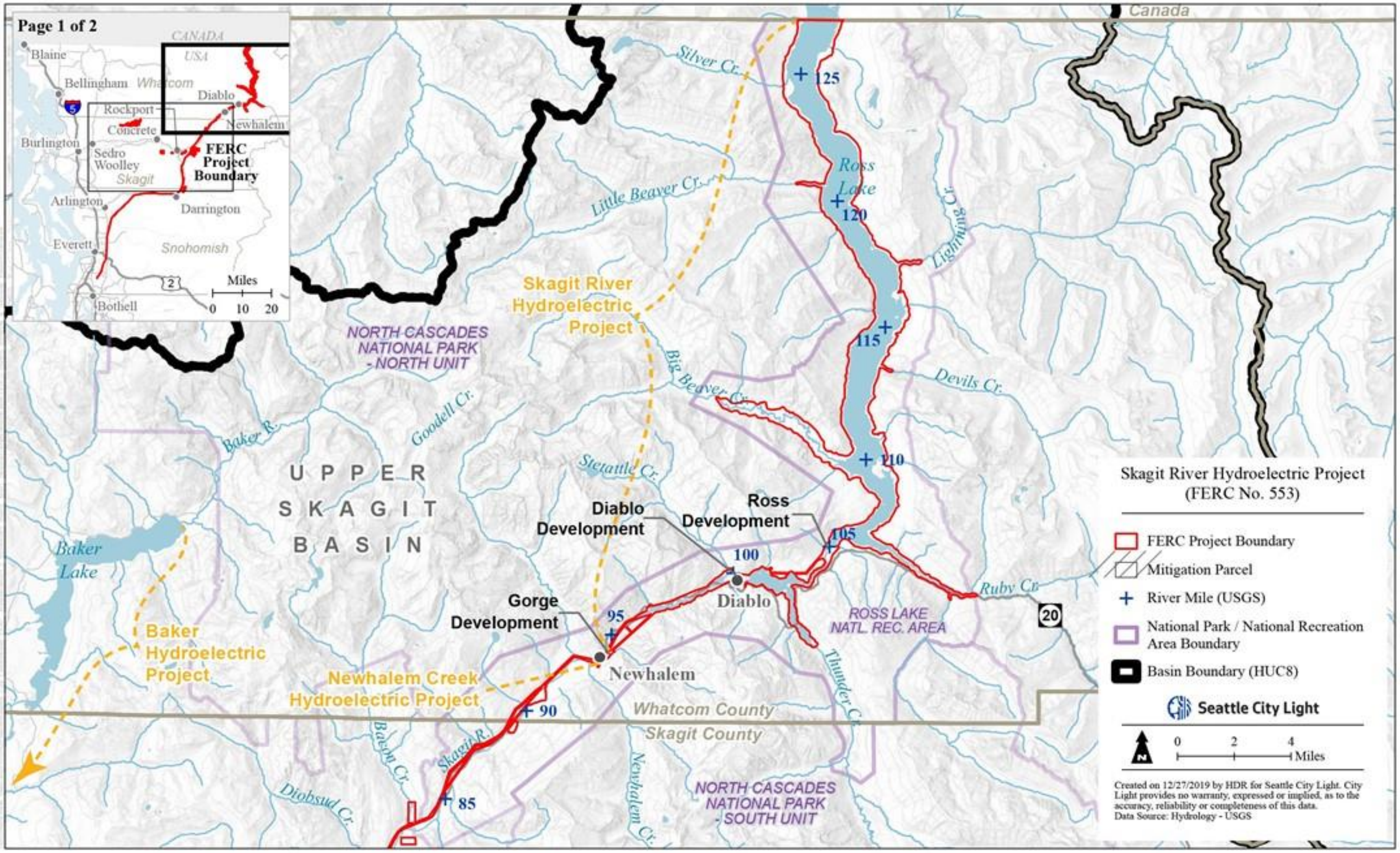


Figure 4.2-1. Location of the Skagit River basin, topography, and other hydroelectric projects in the basin (page 1 of 2).

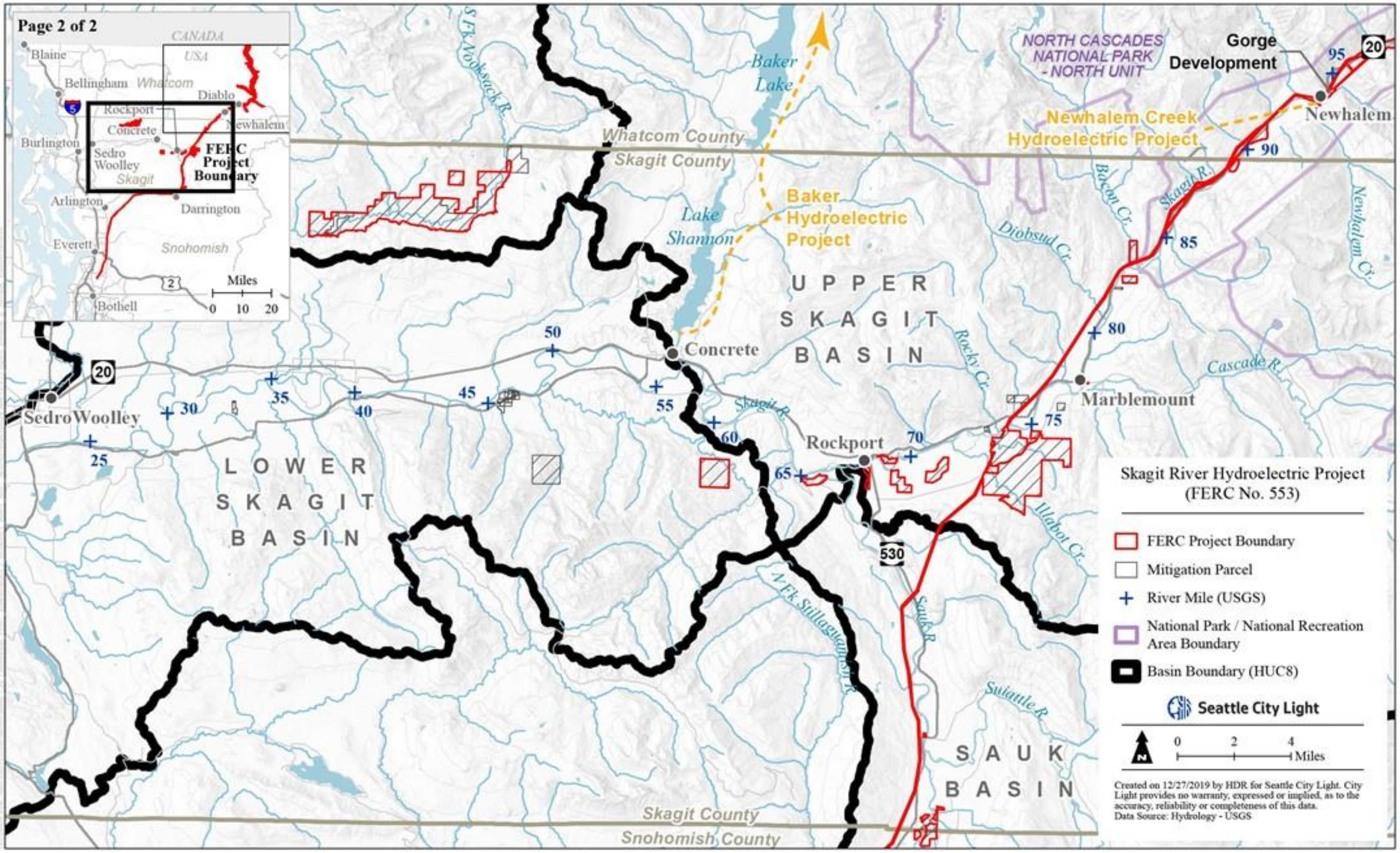


Figure 4.2-1. Location of the Skagit River basin, topography, and other hydroelectric projects in the basin (page 2 of 2).

The reach of the Skagit River from the U.S.-Canada border to Gorge Dam flows through the three Project reservoirs. Ross Dam (RM 105.3) impounds Ross Lake, the uppermost Project reservoir, which has a drainage area of approximately 1,000 sq. mi. and a length of 24 miles. Diablo Dam (RM 101), located downstream of Ross Dam, impounds Diablo Lake, which is about 4.5 miles long, with a cumulative drainage area of about 1,125 sq. mi. (inclusive of the Ross Lake drainage area). Gorge Dam (RM 96.5) is located about 4 miles downstream of Diablo Dam and impounds a 4.5-mile-long reservoir; it has a cumulative drainage area of 1,159 sq. mi. Greater detail on these three Project developments is provided in Section 3; more information on hydrology is found in Section 4.4.

Within the 40-mile reach downstream of the U.S.-Canada border, the channel elevation of the Skagit River drops by 1,100 feet and then declines by another 500 feet over the remaining 95 miles of river. The 2.5-mile-long reach of the Skagit River extending from Gorge Dam to Gorge Powerhouse (bypass reach) flows through a steep, confined canyon that is characterized by bedrock and large boulder substrate. The 39.6-mile-long reach of the Skagit River from Newhalem to Concrete drops approximately 8 feet per mile. The upper half of this reach consists of a steep, rough channel, often confined by rock wall or banks, with a bed composed largely of irregularly shaped boulders and cobbles. The channel in the lower portion of this reach, i.e., from Rockport to Concrete, flows through a valley that ranges from one to three miles wide. Hydraulic travel time from Newhalem to Concrete is about eight hours "at the higher range of flows that occur during flood conditions" (USACE 2013).

The 38.4-mile-long reach of the Skagit River from Concrete to Mount Vernon drops approximately 150 feet (an average of about 3.9 feet per mile [ft/mi.]); gradients range from 5.3 ft/mi. near Concrete to 1.5 ft/mi. downstream of Sedro-Woolley. From Concrete to Sedro-Woolley, the Skagit River flows through a wide valley (one to three miles wide) and below Sedro-Woolley, the valley falls to nearly sea level and widens to a flat, fertile outwash plain. Within this reach, there are numerous side channels, oxbows, and overbank erosion features that are relicts of past floods. Downstream of the town of Hamilton, coarser sediment gives way to fine-grained floodplain sediments. Hydraulic travel time through this reach varies with flow and is typically 15-20 hours at low flow to 10-15 hours at higher flows, although these rates are at times exceeded (USACE 2013).

Downstream of Mount Vernon, the Skagit River flows about six miles and then splits into the North Fork and South Fork distributaries, each of which flows about eight miles to Skagit Bay. During moderate (10-year events) flood conditions, tidal influence extends about 7 miles upstream from the bay on the North Fork and 5 miles upstream on the South Fork. Channel gradient from Mount Vernon to Skagit Bay is about 2 feet per mile. The Skagit River downstream from Mount Vernon is fully confined by levees on both banks, as are the North Fork and South Fork distributaries until they approach Skagit Bay. The channel bed from Mount Vernon downstream is composed mainly of sand (USACE 2013).

4.2.1.1 Topography

The upper Skagit River basin is located in the Cascade Mountains, west of the crest (Figure 4.2-1). Most of the eastern portion of the basin consists of mountainous terrain above an elevation of 6,000 feet and includes 22 peaks exceeding 8,000 feet (USACE 2013). The two most prominent topographical features in the basin are Mount Baker (elevation 10,778 feet) on the western edge of the Baker River basin and Glacier Peak (elevation 10,568 feet) in the Sauk River basin. Almost all tributaries to the Skagit River originate in steep mountain drainages.

Much of the Skagit valley floor east of Sedro-Woolley is bordered by moderately steep, timbered hillsides with little development (USACE 2013). Below Sedro-Woolley, channel elevation is only slightly above sea level, and the river flows through a flat outwash plain that merges with the Samish River valley, which joins from the northeast (USACE 2013). Downstream of Sedro-Woolley, the floodplain forms a large alluvial fan between 11 and 19 miles wide.

4.2.1.2 Climate

The primary factors that influence the climate of the Skagit River basin are terrain, proximity to the ocean, and the position and intensity of semi-permanent high- and low-pressure centers over the northern Pacific (USACE 2013). Maritime air currents create a moist climate with cool summers and mild winters. Annual precipitation varies significantly due to the influence of elevation and topography. The semi-permanent Aleutian Low generates strong storms that at times produce heavy frontal rains in the basin, and during summer, conditions are relatively warm and dry due to the increased influence of the semi-permanent Hawaiian high-pressure system (USACE 2013).

The climate in the Pacific Northwest, including the Project vicinity, is greatly influenced by global-scale patterns of climate variability such as the El Niño–Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) (Abatzoglou et al. 2014). According to Lee and Hamlet (2011), "warm (cool) phases of ENSO and the PDO produce warmer and drier (cooler and wetter) winter in the Skagit River. When ENSO and the PDO are in phase, the climate anomalies are intensified. Averaged October – March temperature is 1.4 degrees Fahrenheit (°F) and 1.7 °F higher for warm phases of the PDO and ENSO in comparison with cool phases of the PDO and ENSO, respectively. When the PDO and ENSO are in phase, the difference of October – March temperature between warm and cool phases is significantly increased to 2.8 °F. Precipitation anomalies are also increased by about a factor of two when the PDO and ENSO are in phase."

Monthly air temperature and precipitation at weather stations near Diablo Dam, Concrete, and Sedro-Woolley for the period 2000-2019 are shown in Table 4.2-1. As expected, average and maximum air temperatures tend to increase with decreasing elevation and proximity to the coast during the cooler months, whereas the opposite is true during the warmer months (due to maritime and orographic influence). The pattern for low temperatures is less consistent. Mean winter temperatures (December – February) near the Project hover just above freezing, whereas summer maximum temperatures at times reach over a 100°F. Average precipitation totals during the colder months tended to be higher at Diablo Dam than at the two lower elevation sites. Some precipitation typically occurs in every month in the Project vicinity, but during July and August there is little or no rain. The highest precipitation typically occurs from November through January, with the monthly peak precipitation typically occurring in November.

Table 4.2-1. Air temperature and precipitation at locations in the upper, middle, and lower Skagit River watershed (2000-2019).

	Diablo Dam			Concrete			Sedro-Woolley		
	Air Temperature (°F)								
Month	**Mean**	**Max (year)**	**Min (year)**	**Mean**	**Max (year)**	**Min (year)**	**Mean**	**Max (year)**	**Min (year)**
Jan	34.4	55 (2015)	2 (2004)	38.3	58 (2005)	10 (2004)	41.0	68 (2015)	13 (2004)
Feb	36.5	59 (2005)	9 (2011)	39.9	68 (2005)	16 (2011)	41.0	63 (2007)	13 (2019)
Mar	40.7	75 (2004)	11 (2009)	43.5	81 (2019)	19 (2009)	45.5	80 (2004)	20 (2009)
Apr	47.2	89 (2016)	26 (2007)	48.7	87 (2016)	29 (2008)	49.7	84 (2016)	27 (2012)
May	55.1	93 (2006)	29 (2006)	55.2	94 (2008)	32 (2006)	55.9	92 (2008)	32 (2011)
Jun	60.1	101 (2017)	40 (2018)	59.6	93 (2017)	41 (2008)	60.2	87 (2003)	39 (2007)
Jul	66.2	104 (2006)	43 (2011)	64.6	99 (2009)	43 (2017)	64.4	98 (2009)	41 (2004)
Aug	66.8	101 (2018)	44 (2000)	65.5	94 (2018)	43 (2008)	64.6	90 (2010)	36 (2006)
Sep	59.8	96 (2003)	37 (2005)	60.1	92 (2006)	38 (2005)	59.4	87 (2017)	33 (2006)
Oct	49.7	80 (2003)	25 (2006)	51.8	80 (2003)	27 (2002)	51.6	78 (2011)	27 (2006)
Nov	39.8	62 (2017)	6 (2006)	43.3	67 (2003)	14 (2010)	45.1	69 (2010)	7 (2014)
Dec	34.0	59 (2007)	2 (2008)	37.7	63 (2014)	10 (2008)	39.7	67 (2005)	9 (2008)
	Precipitation (inches)								
Jan	12.18	21.90 (2006)	5.23 (2017)	10.20	20.18 (2006)	5.83 (2017)	5.91	10.35 (2011)	2.61 (2017)
Feb	6.57	12.50 (2002	1.61 (2004)	6.14	10.48 (2018)	1.90 (2005)	4.02	8.84 (2018)	1.26 (2005)
Mar	9.18	18.74 (2014)	1.10 (2019)	8.37	15.79 (2017)	1.98 (2019)	5.26	8.85 (2014)	2.45 (2019)
Apr	4.69	7.74 (2002)	1.16 (2004)	5.17	9.32 (2018)	0.93 (2004)	4.82	7.66 (2018)	2.54 (2016)
May	2.81	5.79 (2000)	0.62 (2018)	3.27	5.85 (2010)	0.73 (2018)	3.24	6.04 (2014)	0.41 (2018)
Jun	2.08	3.73 (2002)	0.42 (2003)	2.47	4.22 (2012)	0.55 (2015)	2.42	5.01 (2001)	0.27 (2009)
Jul	0.91	2.14 (2012)	0.00 (2017)	1.02	2.18 (2012)	0.00 (2017)	1.09	4.77 (2011)	0.01 (2013)
Aug	1.54	5.26 (2004)	0.00 (2017)	1.50	6.68 (2004)	0.01 (2012)	1.53	7.54 (2004)	0.03 (2012)
Sep	3.63	10.82 (2013)	0.33 (2012)	3.51	9.08 (2013)	0.33 (2012)	3.12	5.69 (2004)	0.20 (2012)
Oct	8.97	23.96 (2003)	0.36 (2002)	7.52	15.22 (2003)	1.36 (2002)	5.20	10.72 (2009)	1.41 (2002)
Nov	13.57	29.41 (2006)	4.56 (2000)	11.62	19.65 (2006)	4.78 (2000)	7.17	11.08 (2015)	2.41 (2000)
Dec	10.61	17.16 (2007)	4.77 (2013)	9.50	15.37 (2015)	4.25 (2000)	4.92	9.36 (2015)	1.84 (2009)
Annual	78.65			71.76			46.31		

Source: National Oceanic and Atmospheric Administration (NOAA) 2019.

Weather records indicate that the climate has changed since the early 20th century. In Washington, temperatures have generally increased, particularly in winter, resulting in a lengthening freeze-free season (Abatzoglou et al. 2014). Precipitation has changed less except for increases in spring (Abatzoglou et al. 2014). In the Project vicinity, records from the Cooperative Observer Program (COOP) at Diablo Dam indicate that average annual temperature has increased 0.1°F per decade since the 1950s, double this during summer. Total precipitation over the water year has increased about 1.2 inches per decade since 1920 (Mauger et al. 2016).

The most recent suite of climate models has projected increases in mean annual temperature of 5 to 9°F in Washington, depending on human activities (e.g., greenhouse gas concentrations) by the end of the 21st century, when compared to 1979-1990 (Rupp et al. 2016). At Diablo Dam, annual average temperatures are projected to increase by 4.3 to 5.7°F by the 2050s (2040-2069), depending on human activities (University of Idaho 2019). According to Abatzoglou and Barbero (2014), climate models project a continued increase in the occurrence of highest temperature records and declines in the lowest temperature records through the mid-21st century. At Diablo Dam, the number of days with a summer heat index ≥ 90°F is projected to increase by four days per year by the 2050s (University of Idaho 2019). Inter-annual variability in temperatures is projected to decrease slightly during the cool season and increase slightly during the warm season (Rupp et al. 2016).

Significant seasonal changes in precipitation are also predicted for the Skagit River basin and Pacific Northwest as a whole, including shifts in the seasonal timing of precipitation, along with more severe flood and low streamflow events (Hamlet et al. 2013; Lee and Hamlet 2011; Mote and Salathé 2010). By the 2050s, annual total precipitation at Diablo Dam is projected to increase by about five inches, with increases in autumn through spring, and decreases during summer (University of Idaho 2019). Inter-annual variability in precipitation is projected to increase, especially during autumn, which indicates that there will be more inter-annual variability in water availability in Washington due to more variable precipitation and more frequent dry days (Rupp et al. 2016; Polade et al. 2015; Kharin et al. 2013).

Prevailing winds in the lower basin (i.e., downstream of Concrete) are generally from the south from September – May and from the north from June – August. In the higher valleys above Concrete, airflow is subject to topographic funneling, generally moving upslope in winter and downslope in summer (USACE 2013). At times during winter, cold continental air from eastern Washington or British Columbia creates down-valley east winds (USACE 2013). In winter, storm winds vary from 20-30 miles per hour and at times reach 60 miles per hour with 100 mile-per-hour gusts over the mountain peaks (USACE 2013). The Project reservoirs and Newhalem and Diablo can experience very strong east-west winds year-round. Modeling indicates no consistent future trend in changes to extreme windstorms over western Washington outside of natural variability (Salathé et al. 2015).

4.2.2 Land and Water Uses

In addition to the area immediately surrounding the Project's generation facilities, the Project Boundary includes about 100 miles of transmission lines that carry the entire load from the Project to the Bothell Substation, which is located north of Seattle. There are also "islands" of fish and wildlife habitat lands and recreation sites within the Skagit, Sauk, and South Fork Nooksack watersheds that are within the Project Boundary. The land within the Project Boundary around the generating facilities is entirely in federal and City Light ownership. Lands within the Project Boundary along the transmission lines include a mix of federal, state, county, and private lands, with most of the federal ownership north of Marblemount.

The Project's generating facilities are located within RLNRA, which was established in 1968 to provide for the "public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge lakes". FERC (formerly FPC) also preserved and maintains jurisdiction over the Skagit River Hydroelectric Project, within RLNRA and existing hydrologic monitoring stations necessary for the proper operation of the hydroelectric projects listed herein (Public Law 90-544. Sec.505 dated October 2, 1968, as amended by Public Law 100-668. Sec. 202 dated November 16, 1988). NPS manages the lands and waters of RLNRA and ensures resource protection and provision of visitor services.

The lands adjacent to RLNRA are within North Cascades National Park, 93 percent of which is also part of the Stephen Mather Wilderness Area. The North Cascade National Park and the wilderness area are both used for recreation but have the primary function of preserving the natural and cultural resources of the North Cascades in Washington State.

The Skagit River downstream of the Project supports all five species of Pacific salmon and is critical to the continued existence of the Puget Sound tribal, commercial, and recreational fishery. Much of the land adjacent to the river from Newhalem to Sedro-Woolley is protected and managed to preserve riparian and wetland areas critical to protect aquatic habitat for salmon spawning, rearing, and foraging.

Land uses between RLNRA boundary (near Bacon Creek) and Rockport include recreation, small-scale agriculture, forestry, grazing, and rural residential. Other water uses in the Skagit River basin downstream of the Project include recreation, domestic and industrial supply, irrigation, commerce, and navigation. The floodplain along the middle and lower Skagit River has been largely cleared of forest and is being maintained for human uses; a large percentage of the floodplain is zoned for agriculture. The Skagit Valley downstream from the town of Concrete contains the largest residential and farming developments in the basin. The 32-mile-long valley between Concrete and Sedro-Woolley is mostly made up of cattle and dairy pasture-land and wooded areas (USACE 2013).

As noted above, the Project transmission lines cross a mixture of public and private lands. Land uses adjacent to the transmission line include recreation, habitat conservation, forestry, residential, and small-scale agriculture.

4.2.3 Tributaries to the Skagit River

Major tributaries to the Skagit River include Thunder Creek, which enters the Skagit River just upstream of Diablo Dam, and the Cascade, Sauk, and Baker rivers, which enter the Skagit River downstream of the Project near the towns of Marblemount, Rockport, and Concrete, respectively (Table 4.2-2; see Section 4.4 for more detail).

Table 4.2-2. Named tributaries that flow into the Skagit River Project reservoirs and the Skagit River to the Sauk River confluence.

Tributary Name	Coordinates at Tributary Mouth
Tributaries to Ross Lake	
Arctic Creek	48.902979, -121.075198
Berry Creek	48.721475, -121.010217
Big Beaver Creek	48.774879, -121.066489
Devils Creek	48.823988, -121.031705
Dry Creek	48.853531, -121.013460
Happy Creek	48.732068, -121.065492
Hozomeen Creek	48.986842, -121.071659
Lightning Creek	48.876296, -121.011004
Lillian Creek	48.724102, -121.015708
Little Beaver Creek	48.917841, -121.126283
Lone Tree Creek	48.722187, -121.006024
May Creek	48.786402, -121.029877
Noname Creek	48.894234, -121.063123
Pierce Creek	48.772114, -121.066161
Roland Creek	48.769102, -121.024168
Ruby Creek	48.711306, -120.984976
Silver Creek	48.970321, -121.103924
Skagit River	49.016484, -121.062636
Skymo Creek	48.851583, -121.035503
Tributaries from Ross Dam to Diablo Dam	
Colonial Creek	48.692100, -121.100518
Deer Creek	48.717630, -121.116239
Horsetail Creek	48.721863, -121.071929
Rhode Creek	48.689572, -121.095102
Riprap Creek	48.729509, -121.073352
Sourdough Creek	48.719350, -121.119820
Thunder Creek	48.677634, -121.077118
Tributaries from Diablo Dam to Gorge Powerhouse	
Gorge Creek	48.700237, -121.208436
Pyramid Creek	48.712831, -121.153656
Stetattle Creek	48.717082, -121.149531
Tributaries from Gorge Dam to the Sauk River Confluence	
Alma Creek	48.600021, -121.361291
Babcock Creek	48.662470, -121.285029
Bacon Creek	48.585668, -121.393408
Barr Creek	48.491919, -121.548903
Cascade River	48.521438, -121.431504
Copper Creek	48.590653, -121.372832
Corkindale Creek	48.504962, -121.485168

Tributary Name	Coordinates at Tributary Mouth
Damnation Creek	48.626058, -121.336772
Diobsud Creek	48.559083, -121.412556
Goodell Creek	48.672718, -121.264604
Illabot Creek	48.498213, -121.504134
Ladder Creek	48.675407, -121.240445
Martin Creek	48.652921, -121.287166
Newhalem Creek	48.671376, -121.256080
Olson Creek	48.526828, -121.446081
Rocky Creek	48.500800, -121.494661
Sauk River	48.481244, -121.605543
Sky Creek	48.629898, -121.327914
Sutter Creek	48.493538, -121.544098
Taylor Creek	48.538696, -121.425637
Thornton Creek	48.648456, -121.304222

4.2.4 Dams and Diversion Structures

In addition to the Skagit River Hydroelectric Project, there are two other hydroelectric projects in the Skagit River drainage: the Baker River Hydroelectric Project (FERC No. 2150) located on the Baker River and the Newhalem Creek Hydroelectric Project (FERC No. 2705) located on Newhalem Creek (Figure 4.2-1). Table 4.2-3 includes select data for these two projects.

Table 4.2-3. Select project data for the Baker River and Newhalem Creek hydroelectric projects.

Project Name	Project Owner	Location (RM) of Project Dams	In-Service Date	Drainage Area Upstream of Dam (sq.-mi.)	Gross Reservoir Storage (acre-feet)
Newhalem Creek Hydroelectric Project (FERC No. 2705)	Seattle City Light	Newhalem Creek Diversion Dam (RM 1.8)	1921	26.9	NA
Baker River Hydroelectric Project (FERC No. 2150)	Puget Sound Energy	Upper Baker Dam (RM 9.35)	1959	210	274,221
		Lower Baker Dam (RM 1.2)	1925	297	146,279

4.2.4.1 Newhalem Creek Hydroelectric Project

The Newhalem Creek Hydroelectric Project, which is owned and operated by City Light, began operation in 1921 to provide power for the town of Newhalem and construction of the Skagit River Project. The Project consists of a 45-foot-long, 10-foot-high dam located at RM 1.8 on Newhalem Creek; a 2,700-foot-long tunnel; a 500-foot-long penstock; a powerhouse containing a single Pelton turbine unit with a generating capacity of 2.3 MW; a 350-foot-long tailrace; and a 4,387-foot-long transmission line. The Project is operated in run-of-river mode and has a diversion pool with a surface area of only 0.1 acres. With a minimum flow of 20 cfs, the Project does not typically operate from late July through September.

4.2.4.2 Baker River Hydroelectric Project

The Baker River Hydroelectric Project is owned and operated by Puget Sound Energy (PSE) under a FERC License issued in 2008. The project is located on the Baker River in Skagit and Whatcom counties, upstream of the town of Concrete. The Project consists of the Lower and Upper Baker developments.

The Lower Baker Development includes a concrete arch dam located 1.2 RMs upstream of the confluence of the Baker and Skagit rivers, a seven-mile-long reservoir (Lake Shannon), a power tunnel, and a single-unit powerhouse at RM 0.9 (PSE 2004). Lower Baker Dam is 285 feet high and 550 feet long; the top of the dam is at elevation 450.62 feet mean sea level (msl; NAVD 88). Lake Shannon has a surface area of 2,278 acres at the normal maximum water surface elevation of 442.35 feet msl (NAVD 88) (PSE 2004). The gross storage capacity above elevation 343.75 feet msl (NAVD 88) is 146,279 acre-feet (PSE 2004). The minimum generating water surface elevation is 373.75 feet msl (NAVD 88), which provides usable storage of 116,770 acre-feet (PSE 2004). There are two powerhouses for the Lower Baker Project – the original one constructed in 1925 and containing a single 79-MW turbine – and a new powerhouse completed in 2013 with a 30-MW turbine (Nigus et al. 2014).

The Upper Baker Development consists of a concrete gravity dam at RM 9.35, an earthen dike, a nine-mile-long reservoir (Baker Lake), a two-unit powerhouse, and associated facilities (PSE 2004). Upper Baker Dam is 312 feet high and 1,200-feet long; the top of the dam is at elevation 735.77 feet msl (NAVD 88) (PSE 2004). Baker Lake is about 1 mile wide and has a surface area of 4,980 acres at the normal maximum water surface elevation of 727.77 feet msl (NAVD 88) (PSE 2004). The gross storage capacity of Baker Lake is 274,221 acre-feet. The minimum generating water surface elevation is 677.77 feet msl (NAVD 88), which provides usable storage of 180,128 acre-feet (PSE 2004). The Upper Baker powerhouse contains two turbine generator units, which have an authorized installed capacity of about 90 MW (PSE 2004).

4.3 Geology and Soils

This section summarizes the geology and soils of the Project vicinity and describes the characteristics of the shorelines surrounding Project reservoirs and the Skagit River. In this section, Project vicinity is defined as the Project structures and reservoirs, transmission line ROW from the powerhouses to Bothell Substation, Gorge bypass reach, Marblemount and Sauk River boat launches, and fish and wildlife mitigation lands in the Skagit, Sauk, and South Fork Nooksack watersheds. See Figure 3.4-28 in Section 3 of this PAD for locations of the fish and wildlife mitigation lands.

Information provided in this section was summarized from existing data, reports, and literature. Primary data sources include:

- Washington DNR technical reports and information on geology and geologic hazards
- NPS technical reports on geology, soils, and landforms

- National Resource Conservation Service (NRCS) Soil Information
- Reports on slope stability and erosion around the reservoirs from the last license and subsequent studies

4.3.1 Geology

The geologic characteristics of the Project vicinity and surrounding terrain vary considerably from the rugged North Cascades with high peaks and steep valleys, to the Cascade foothills with broader alluvial valleys, to the Puget Lowland with subdued topographic features reflecting shaping and deposition under thick continental glaciers. The following sections summarize important geologic features in the Project vicinity.

4.3.1.1 Geologic Setting

The dams, reservoirs, powerhouses, many of the fish and wildlife mitigation lands, and northeastern portion of the transmission line corridor are located in the North Cascades Range. The North Cascades is an extremely complex mosaic of geologic terranes that were formed as the Pacific Ocean plate and the North American continental plate collided, breaking off pieces of volcanic island arcs, deep ocean sediments, ocean floor, continental rocks, and subcrustal mantle over the past 400 million years (Haugerud and Tabor 2009). These terranes were then uplifted, thrust on top of each other, eroded, or buried to further complicate the geology in the area. About 40 million years ago, volcanoes developed on this mosaic of terranes, covering some areas with lava and ash and intruding granite and granodiorite that were subsequently eroded and exposed.

During the Quaternary Period, starting about 2.6 million years ago, continental and alpine glaciers covered much of the area in the Project vicinity, with several major advances of thick continental ice from the north and smaller alpine glaciers originating from mountain peaks. The most recent continental glacial advance, culminating approximately 15,000 years ago, resulted in many of the surficial geologic features and deposits in the North Cascades and all the surficial geology in the Puget Lowland portion of the Project vicinity where the southwestern portion of the transmission line is located. The glacial history has had a profound effect on the Skagit River, directing the previously north-flowing Skagit River into the current south-flowing river valley near Ross Lake and leaving thick deposits of semi-consolidated sediments that have been subsequently eroded by mass wasting, streams, and rivers.

4.3.1.2 Bedrock Geology

Bedrock geology of the Project vicinity can be grouped into three major domains, all bounded by fault zones: the Western Domain that includes low-grade metamorphic rocks and underlies the western transmission line corridor and many of the fish and wildlife mitigation parcels; the Metamorphic Core Domain of higher-grade metamorphic rocks under the dams and transmission line from Marblemount to the middle of Ross Lake; and the Methow Domain under the northern part of Ross Lake. In addition, recent sediments occur in all three domains (Figure 4.3-1 and Table 4.3-1).

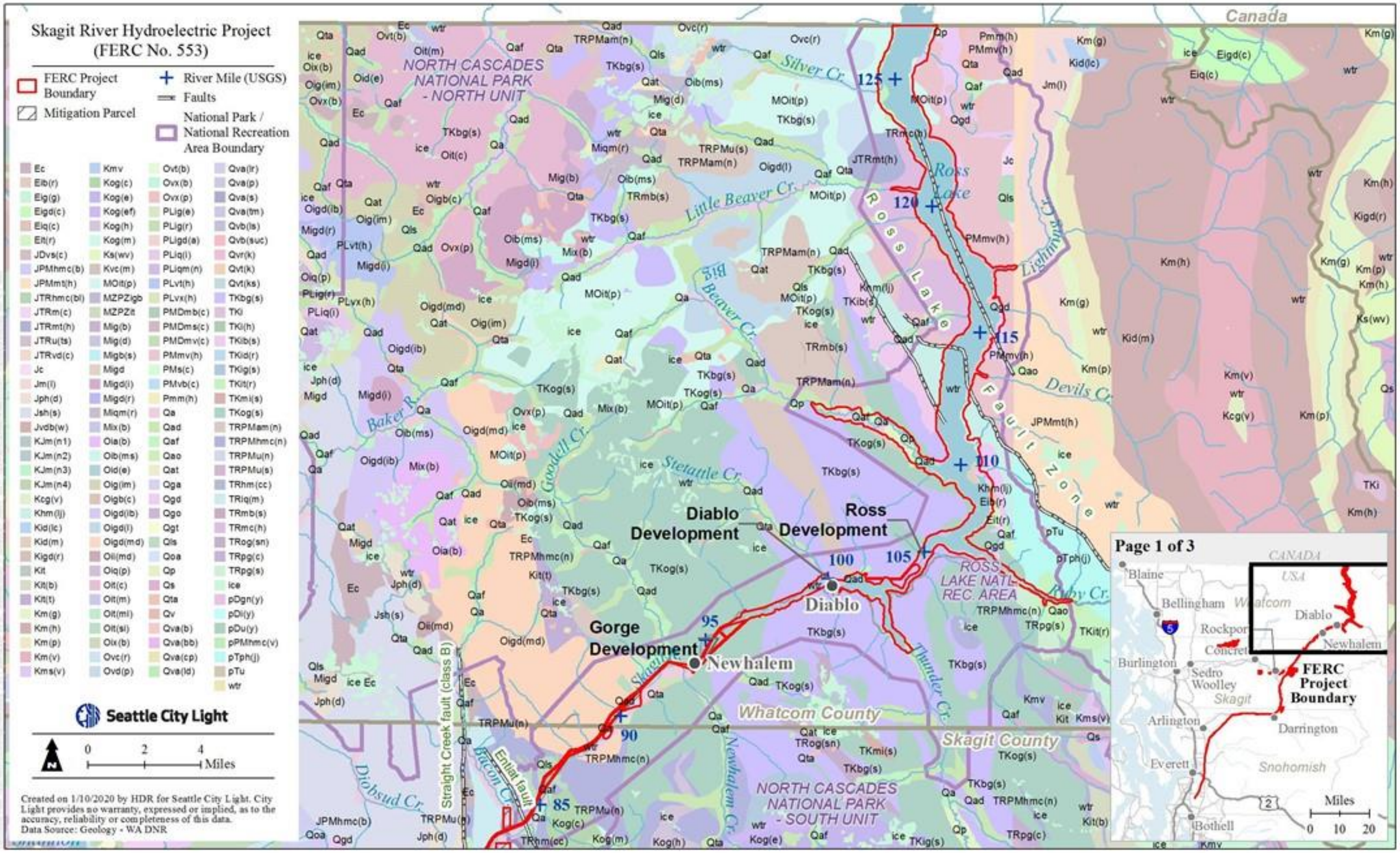


Figure 4.3-1. Geologic features of the Project vicinity (page 1 of 3).

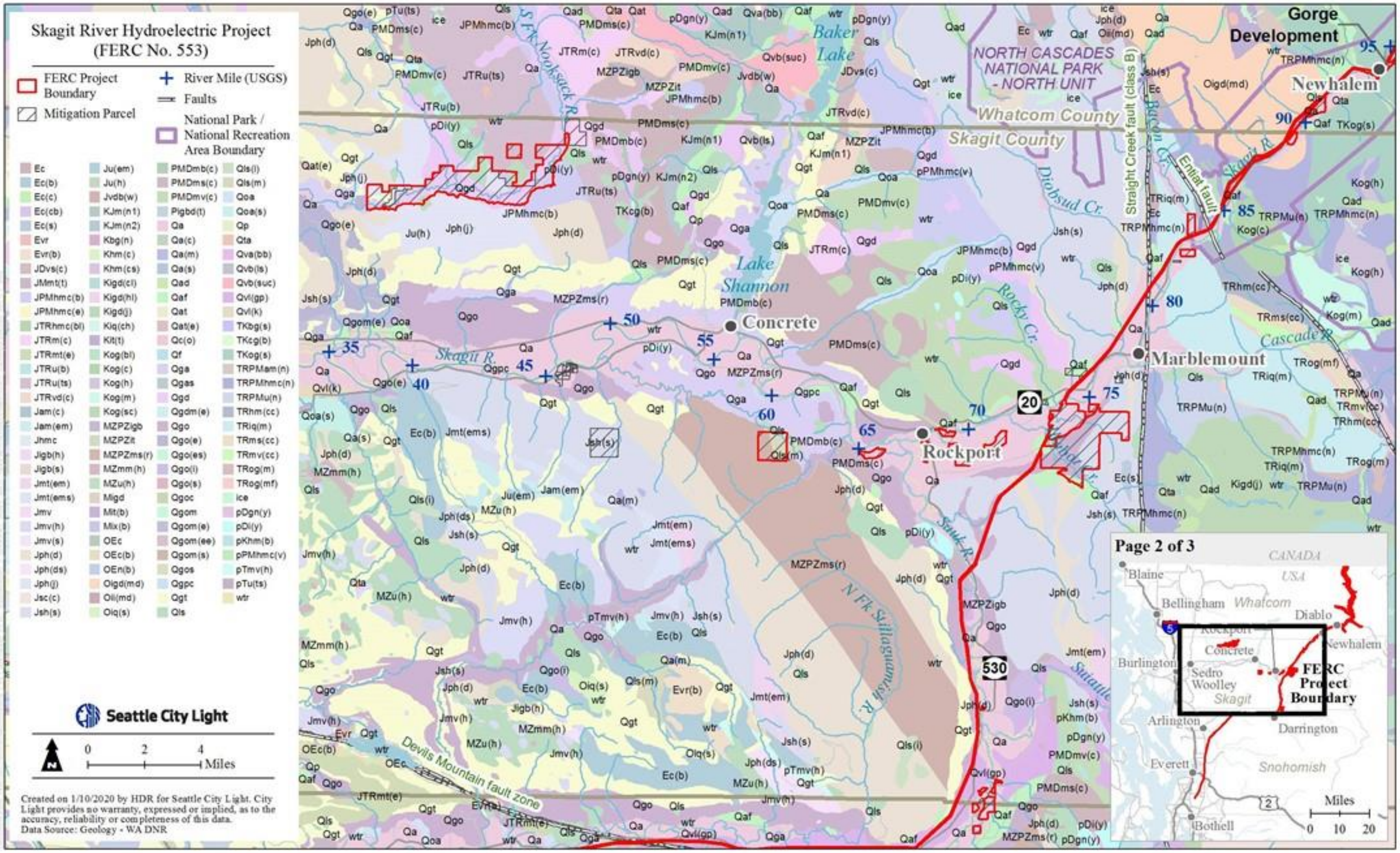


Figure 4.3-1. **Geologic features of the Project vicinity (page 2 of 3).**

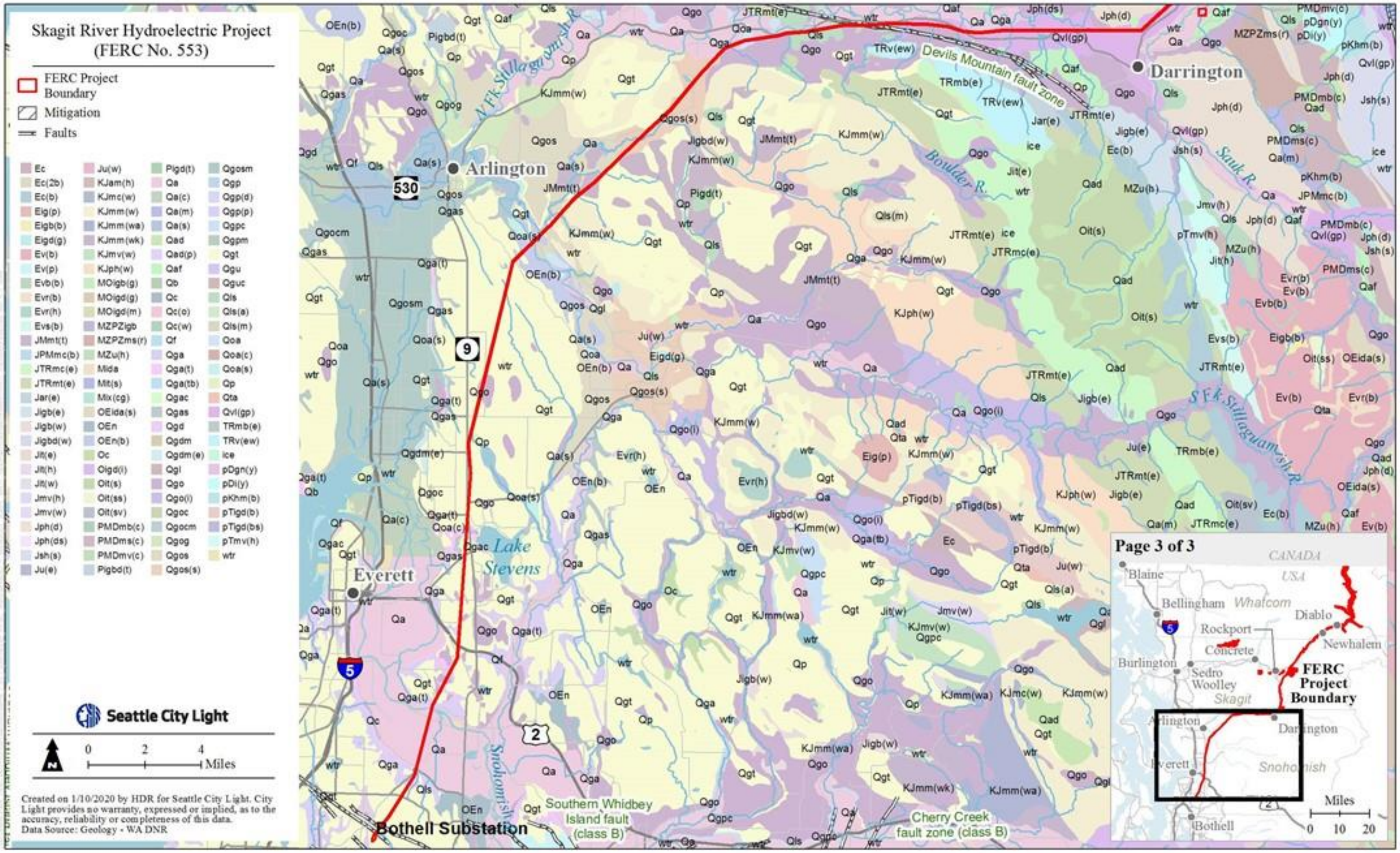


Figure 4.3-1. Geologic features of the Project vicinity (page 3 of 3).

Table 4.3-1. Major geologic units in the Project vicinity.

Domain	Map Symbol	Name	Age	Description
Recent Sediments	Qa	River valley alluvium	Holocene, Pleistocene	Valley bottom sand and gravel in rivers and streams
	QTl	Landslide deposits	Holocene, Pleistocene, Tertiary	Rocks, soil, and debris derived from landslides
	Qlh	Lahar deposits	Holocene, Pleistocene	Muddy, gravelly volcanic rock debris formed by catastrophic mudflows associated with volcanic eruptions
	Qvt, Qvr	Glacial till and outwash	Holocene, Pleistocene	Glacial deposits ranging from consolidated boulders, sand, gravel, and finer particles to sand and gravel deposits of glacial outwash rivers
Western	Tcai	Intrusive rocks of the Index Family	Tertiary (Oligocene)	Granodiorite and granite
	TKwb	Western Mélange Belt	Tertiary to Cretaceous	Lightly metamorphosed sandstone and semischist interbedded with argillite and phyllite. Can include other low-grade metamorphic rocks
	TKeb	Eastern Mélange Belt	Tertiary to Cretaceous	Mafic volcanic rocks and chert with a mix of other metamorphic rocks
	Ked	Darrington Phyllite	Cretaceous	Black phyllite with abundant small quartz veins, complexly folded
	Kes	Shuksan Greenschist	Cretaceous	Fine-grained greenschist and blueschist
	Jph	Mt. Josephine semischist	Jurassic	Schist, phyllite
	JTRmc	Bell Pass Melange	Jurassic to Triassic	Mix of cherts, shale, basalt, and ultramafic rocks
	PDc	Chilliwack Group	Permian to Devonian	Gray to brown and black argillite and sandstone with minor conglomerate, marble, and chert
Metamorphic Core	Kg	Granodiorite plutons	Cretaceous	Granodiorite and orthogneiss to tonalite plutons
	Kmd	Marblemount plutons	Cretaceous	Quartz diorite, metatonalite, gneiss with light colored dikes
	TKsg	Skagit Gneiss Complex		Schist, amphibole, rare marble and ultramafic rocks intruded by sills of igneous rocks; metamorphosed to orthogneiss
	TKso	Othogneiss	Tertiary to Cretaceous	Gneissic hornblende-biotite tonalite
	TKgo	Granodioritic orthogneiss	Tertiary to Cretaceous	Granodioritic orthogneiss grading to tonalite
	TKns	Napeequa Schist	Tertiary to Cretaceous	Fine-grained hornblende-mica schist and amphibolite-quartz schist
	TKsx	Skymo Complex	Tertiary to Cretaceous	Metamorphosed gabbro and ultramafic rocks

Domain	Map Symbol	Name	Age	Description
	TKm	Metamorphosed rocks of the Methow Ocean	Tertiary to Cretaceous	Metamorphosed shale, sandstone, and conglomerate
Methow	Tcas	Intrusive rocks of the Snoqualmie family	Tertiary (Miocene and Oligocene)	Tonalite, granodiorite, granite, and rare gabbro
	Tcao	Volcanic and sedimentary rocks of the Ohanapecosh episode	Tertiary (Oligocene)	Basalt, andesite, and rhyolite
	MzPzh	Hozomeen Group	Mesozoic and Paleozoic	Basalt, sandstone, shale, and chert

Source: Washington DNR 2019.

The major fault zones bounding the geologic domains are the Straight Creek Fault and the Ross Lake Fault Zone, which include the Hozomeen Fault (Figure 4.3-1; Haugerud and Tabor 2009). The Straight Creek Fault is thought to be an approximately 250-mile-long, north-south trending, strike-slip extensional fault. It begins in Central Washington and extends 130 miles into Canada. The fault separates low-grade metamorphic rocks to the west from highly metamorphosed rocks of the North Cascades core to the east. The Ross Lake Fault separates the metamorphic core of the North Cascades from the sedimentary and volcanic deposits of the Methow Domain to the east. The Ross Lake Fault System is part of a 310-mile-long zone of high angle faults that trends northwest-southeast. The Big Beaver valley and other sub-watersheds that drain into Ross Lake are influenced by the preferential trend of this fault system. Tertiary arc plutons, primarily of the Chilliwack Composite Batholith, have erased some evidence of both faults in Washington and southernmost British Columbia. The Hozomeen Fault is east of Ross Lake and defines the trend of upper Lightning Creek. Lesser faults include the Thunder Lake fault, which crosses McMillan Creek up into Arctic Creek and follows the trend of the Straight Creek Fault.

Rocks of the Western Domain include a folded stack of lightly metamorphosed terranes that were thrust and folded, intruded by younger volcanic rocks, and eroded to expose older rocks on top of younger rocks (Haugerud and Tabor 2009; Tabor and Haugerud 1999). Geologic units include the Western and Eastern Mélange Belts, lightly metamorphosed sandstone, semischist, argilite, and volcanic rocks of oceanic origin; the Darrington Phyllite that is deep ocean mud and sand that has been metamorphosed; and the Shucksan Greenschist formed from ocean floor basalt that was altered at shallow depths in a relatively cool geologic environment and contains an unusual dark blue amphibole. Rocks of the Chilliwack Group, also lightly metamorphosed argillite and sandstone, are thought to have been deposited on long-lived volcanic arcs about 375 to 250 million years ago. These terranes were intruded by granodiorite and granite about 30-35 million years ago by magma of the Cascade Magmatic Arc.

Rocks of the Metamorphic Core Domain display higher levels of metamorphism and are more resistant to weathering and erosion, resulting in the high peaks of the North Cascades. These geologic units include gneiss, orthogneiss, and schist that underlie the Project dams, Gorge Lake, Diablo Lake, and the southern part of Ross Lake. While resistant to erosion, the steep valleys formed in these hard rocks are subject to rockfalls, landslides, and avalanches. North of Ross Dam, rocks of the Skymo Complex and Methow Ocean metamorphic rocks form the shoreline of Ross Lake and include metamorphosed units of gabbro, ultramafic rocks, shale, sandstone, and conglomerate. Several areas of Tertiary intrusive volcanic rocks occur in the Metamorphic Core Domain and include granodiorite, orthogneiss, and quartz diorite.

Rocks of the Methow Domain around the northern part of Ross Lake include the Hozomeen Group as well as Tertiary volcanic intrusive and extrusive rocks. The Hozomeen Group consists of ocean-floor basalt, sandstone, shale, and chert. The Hozomeen Chert was highly prized and quarried for use for tools and weapons by Native American and First Nation peoples.

The southern extent of the transmission line corridor and many of the fish and wildlife mitigation lands traverse river valleys and the Puget Lowland where surficial deposits include till and outwash left during Pleistocene ice advances as well as recent stream alluvium. These deposits vary from consolidated till (containing clay to boulder particles) to unconsolidated stream sand and gravel.

4.3.1.3 Glacial Geologic History

The topography of the North Cascades and Puget Lowland reflects multiple glaciations occurring during the last 2.6 million years. These events carved deep U-shaped valleys, steep valley walls, and jagged horns and arêtes in the North Cascades and smoothed the topography in the Puget Lowland. The geomorphology of the North Cascade Range during this period has been shaped by both alpine and continental glaciations (U.S. Department of Agriculture [USDA] et al. 2012). Impacts from the ice sheet are evident throughout the North Cascade Range and include broad passes and beveled ridges, enlarged valley cross-sections, truncated valley spurs, and thick accumulations of till and outwash. Between multiple ice sheet glaciations, valley glaciers flowed from cirques throughout the area, forming large, complex valley glacier systems. Tributary systems were left as hanging valleys with bedrock canyons or narrow-stepped waterfalls at the mouth (USDA et al. 2012).

Both local and regional drainage patterns have been altered by glaciation (Riedel et al. 2007). The North Cascade Range and Puget Lowland was inundated by the south-flowing Cordilleran Ice Sheet during the Fraser Glaciation 35,000 to 11,500 thousand years ago. The Cordilleran Ice Sheet that advanced into the area from the north was greater than one mile thick at what is now Ross Lake and in the Puget Lowland (Armstrong et al. 1965; Porter and Swanson 1998). Glacial ice dams blocked the northerly flowing Skagit River and created lakes that drained to the south, forming deep canyons. After the ice sheet retreated, the Skagit River and nearby creeks were re-directed to flow south in its current configuration (Riedel et al. 2012). Other river valleys along the transmission line corridor were locations of former meltwater channels adjacent to the ice sheet, resulting in wider valleys than the current rivers would easily form. Currently, the Skagit watershed has more than 300 glaciers. The headwaters of several tributaries to Ross Lake and Diablo Lake include glaciers, most notably in the Thunder Arm drainage in Diablo Lake (Granshaw 2002).

The change in course of the Skagit River from north-draining to south-draining has implications for the life history and strains of fish currently occupying the Skagit River, as further discussed in the Section 4.5 of this PAD.

4.3.1.4 Mineral Deposits and Mining

The metamorphic and volcanic rocks of the North Cascades host numerous mineral deposits including gold, silver, copper, lead, and zinc. Nonmetallic minerals and resources include sand, gravel, and building stone.

Prospectors in the mid- to late 1800s were searching for gold and found it in placer deposits along the banks of the Skagit River and Ruby Creek. Despite the difficult access, miners flocked to the upper Skagit watershed in search of gold. After only marginal success in gold mining, silver and other minerals were extracted from the 1890s to 1940s with similar limited success due to the difficult access, short working season, and low ore quality. Several private mining inholdings remain in the upper Skagit watershed, including the Thunder Creek Mine.

The production of metallic minerals in the North Cascades from 1900 to 1965 was from 32 mines which yielded primarily gold. Gold was 98 percent of total metallic mineral production in the North Cascades during this time. Silver, copper, lead, and zinc made up the remaining two percent of the total metallic mineral production. The past production of nonmetallic minerals consisted of coal, limestone, sand and gravel, clay, peat, building stone, quartz, and olivine. In 1966, none of the mines were producing metals and the area’s mineral production was mainly limestone, sand and gravel, olivine, and stone (Moen 1969).

According to “The Diggings,” Whatcom County has 2,115 mining claims listed on public lands that are managed by the Bureau of Land Management (BLM) and 365 records of mineral deposits listed by the USGS. The largest mineral claims in the county are gold (147), chromium (76), copper (30), limestone (29), and silver (26). Of these claims, 98 percent are currently closed and only two percent (~47) are still active. There are still several active mines located in the Project vicinity in the communities of Newhalem and Diablo. Newhalem includes 97 nearby mines, 94 of which are currently closed, and 3 remaining active. Diablo includes 402 mines, of which 375 are currently closed, and 27 remaining active (The Diggings 2019). At least one parcel of mitigation land near Bacon Creek has been used as a gravel borrow pit in the past.

Recently proposed mining activity in the Project vicinity includes a quarry rock expansion for jetty and shoreline armoring material at an existing pit near the town of Marblemount and gold and copper exploration in the Skagit Headwaters in Canada. Plans for the quarry near Marblemount were suspended by the owner in September 2019.

4.3.1.5 Geological Hazards

Faults and Seismicity

Western Washington is a seismically active region located along the Cascadia Subduction Zone, a north-south trending convergent plate boundary where the Juan de Fuca Plate is being subducted beneath the North American Plate. The major fault zones in the region are shown on Figure 4.3-1 and include: the Straight Creek Fault, the Entiat Fault, the Ross Lake Fault System, and the Darrington-Devils Mountain Fault Zone (Tabor and Haugerud 1999; Dragovich et al. 2002). No appreciable Holocene (last 10,000 years) tectonic activity has been documented along any of the fault systems in the North Cascades (Riedel et al. 2012). Older, inactive thrust faults are also present near the Project, but these faults have not been shown to have had Quaternary-age movement. The Darrington-Devils Mountain Fault Zone is designated by the USGS as a Class A fault that is capable of generating an earthquake. The most recent prehistoric deformation associated with the Darrington-Devils Mountain Fault Zone is Late Quaternary, or less than 130,000 years ago (Johnson et al. 2001). The steeply dipping (45 to 90 degrees), left-lateral Darrington-Devils Mountain Fault Zone has a slip rate of less than 0.2 millimeters/year (Johnson et al. 2001). No data on the recurrence interval or the maximum credible earthquake for the Darrington-Devils Mountain Fault Zone are available. The southern end of the transmission line corridor crosses the Southern Whidbey Island Fault Zone; no movement on this fault is recorded in the Holocene (Sherrod et al. 2008).

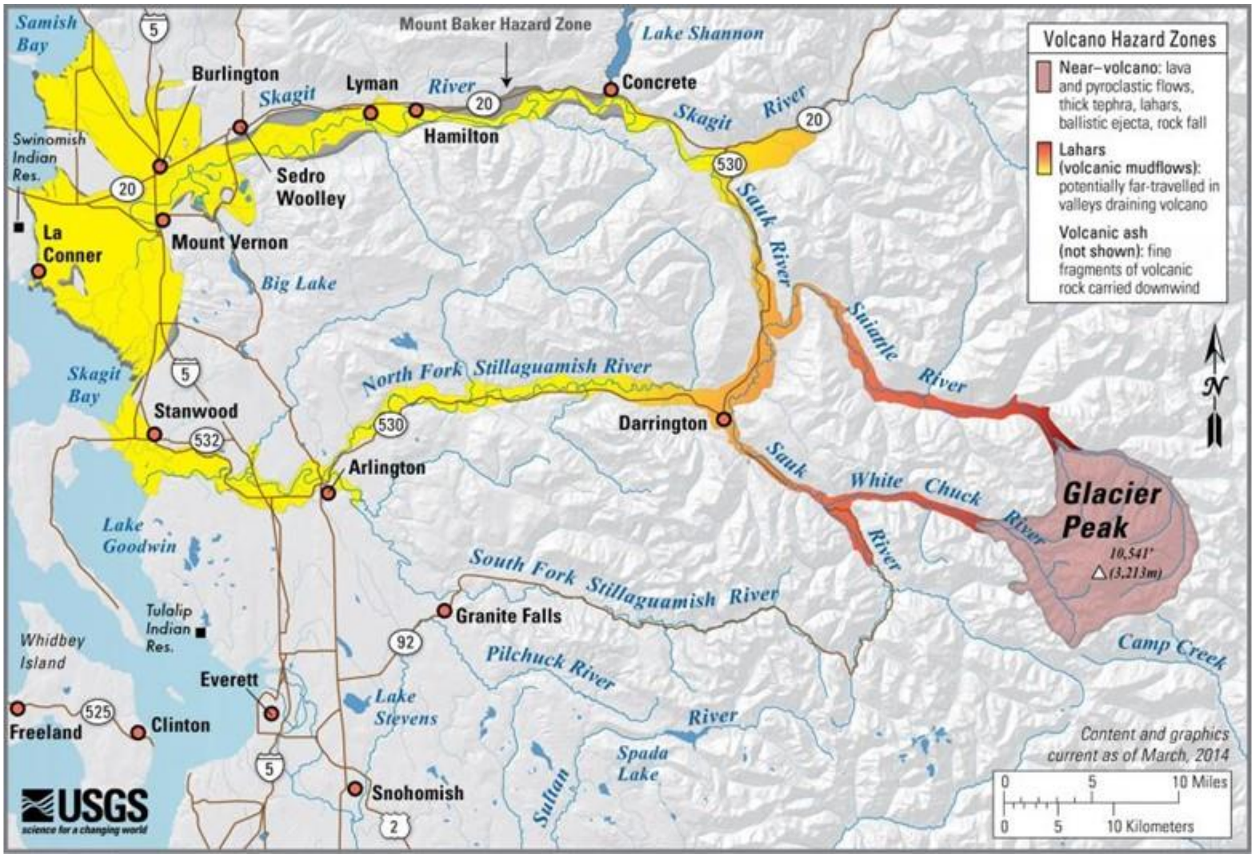
Only crustal and intraplate earthquakes have been detected in the Pacific Northwest over the last 300 years. The last subduction zone (interplate) earthquake occurred in AD 1700. Table 4.3-2 lists earthquakes that affected northwest Washington (in order of decreasing intensity). The two earthquakes affecting the North Cascades, occurring in 1872 and 1915, were centered approximately 25 miles and 45 miles from the Gorge Development, respectively. The 7.3 magnitude earthquake in 1872 was the largest recorded in the region and is believed to have occurred somewhere between the south end of Ross Lake and the north end of Lake Chelan. The most recent earthquakes affecting the Project have been in the 3-4 magnitude range and centered west of the Project reservoirs (Riedel et al. 2012).

Table 4.3-2 Large historic earthquakes measured in northwestern Washington.

Year	Location	Magnitude	Type (Mechanism)
1946	Vancouver Island	7.3	Intraplate
1872	North Cascades	7.3	Crustal
1918	Vancouver Island	7.0	Crustal
1949	Olympia	6.8	Intraplate
1965	Seattle-Tacoma	6.8	Intraplate
2001	Nisqually (Olympia)	6.8	Intraplate
1915	North Cascades	5.6	Unknown

Lahars and Volcanic Hazards

Lahars and ash fall hazards are associated with the active volcanoes in the Cascades; the two volcanoes closest to the Project are Mt. Baker and Glacier Peak. The primary hazards to the Project from Mt. Baker are from ash fall, since no Project features are downstream from the mountain. Hazards from Glacier Peak include lahars and ash fall. Glacier Peak is located south and east of the Project, and the transmission line corridor crosses historic Glacier Peak lahar runout zones. Since the continental ice sheets receded from the region approximately 15,000 years ago, Glacier Peak has erupted repeatedly during at least six episodes with the most recent lahar approximately 1,800 years ago. Two of these eruptions were among the largest in the Cascades during this time period. Figure 4.3-2 shows lahar hazard zones originating from Glacier Peak (Cascade Volcano Observatory 2019).



Source: Cascades Volcano Observatory 2019.

Figure 4.3-2. Lahar hazards from Glacier Peak.

Mass Wasting

Steep topography, narrow valleys, and heavy precipitation combine to produce mass wasting hazards within the North Cascades region of the Skagit River Project. Valley walls produce snow avalanches, rock falls, debris avalanches, shallow-rapid landslides, deep-seated landslides, and debris torrents. Canyons such as Skagit Gorge are particularly hazardous locations because of the frequency and size of these events. SR 20 through the Skagit Gorge is often closed during the winter due to hazards from rock falls, debris avalanches, and snow slides (Riedel et al. 2012).

NPS mapped 189 individual mass movements in RLNRA (refer to Figure 4.3-5 and Table 4.3-5 below) as part of the North Cascades landform inventory. Mass movements are divided into categories based on failure type and material. These include debris avalanches, rock falls/topples, debris torrents, sackungs, slumps/creeps, and snow-avalanche impact landforms. Two large historic landslides are now flooded by Ross Lake: one that came off of the west face of Desolation Peak and another from the west valley wall across from Devils Creek. A large landslide near Damnation Creek about 8,000 to 6,000 years ago blocked the Skagit River and formed Lake Ksnea (Riedel et al. 2009).

In the past, large debris avalanches have occurred throughout the watershed as a result of fall and winter rain events. Some of these landslides delivered substantial amounts of sediment to creeks and caused aggradation, flooding, and downstream erosion. Heavy precipitation in December 2003 triggered two large debris avalanches that impacted SR 20. In the Skagit Gorge there was a debris avalanche that released several hundred thousand cubic yards of rocky debris that was deposited above the highway in the headwaters of Afternoon Creek. Another 2003 landslide at Goodell Creek delivered approximately 3.8 million cubic yards of debris causing aggradation of lower Goodell Creek and impacting the highway and NPS campgrounds (Riedel et al. 2012). A debris avalanche downstream of Ross Powerhouse in 2010 closed the Ross Haul Road from the powerhouse to the top of the dam for several months until the road could be cleared and the slope stabilized.

There are limited mass wasting hazards along the transmission line from the Bothell Substation through the Puget Lowlands (approximately 20 miles), but mass wasting and rockfall along the transmission line corridor throughout many sections of the 80-mile traverse through the Cascade Foothills and North Cascades region pose a hazard. Shallow-rapid landslides along steep slopes, slower soil slumps and creep, and the possibility of large, deep-seated landslides like the one that occurred in Oso, Washington in 2014, could occur at susceptible locations along the transmission line, particularly between Arlington and the Sauk River crossing, and could affect transmission line towers. Rockfall and debris avalanche hazards exist in steep areas of the transmission line corridor north of Newhalem. Past landslides in some areas have been compiled by the Washington DNR and show several past slides along the transmission line corridor, as well as within some fish and wildlife mitigation lands (Figure 4.3-3; Washington DNR 2019) and provide information about regions with higher risk of mass wasting.

Flooding and Channel Migration

Flooding in narrow canyons presents a hazard. Steep valley walls and small streams deliver water rapidly to larger streams, causing them to quickly rise and increase velocities. Flooding can also present a hazard at stream crossings along the transmission line corridor, but the majority of transmission towers and access transmission line roads are located outside of floodplains. Channel migration and bank erosion at stream crossings in wide alluvial valleys may pose a more significant hazard to transmission line towers. Several transmission line towers have been relocated or subjected to bank erosion protection measures to minimize hazards in select locations (e.g., Boulder River, French Creek, Diobsud Creek). At the Skagit River crossing near Marblemount (Corkindale Creek vicinity), power poles have been designed with deep foundations to allow the Skagit River to migrate around them without risk of undermining.

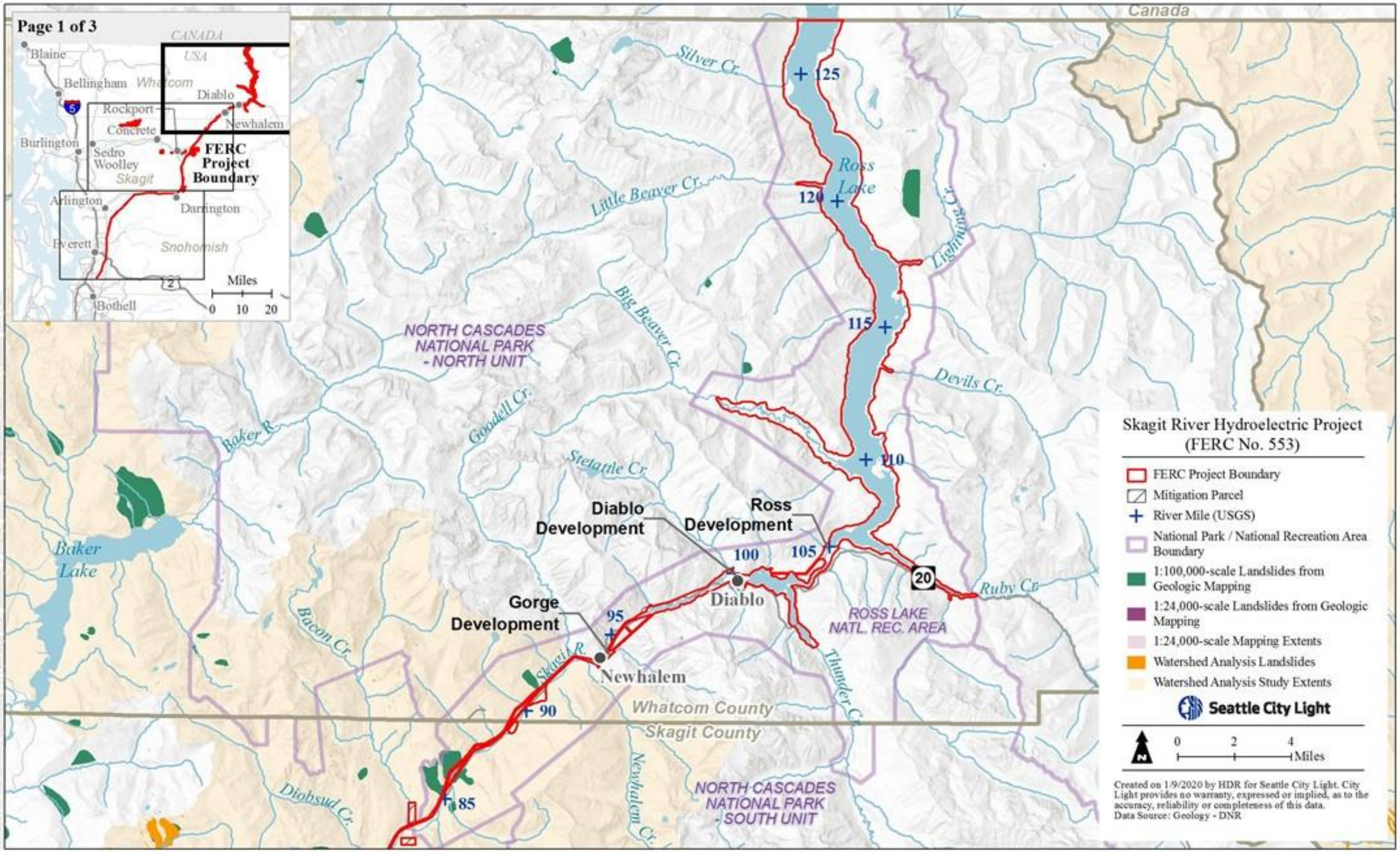


Figure 4.3-3. Landslides in the Project vicinity (page 1 of 3).

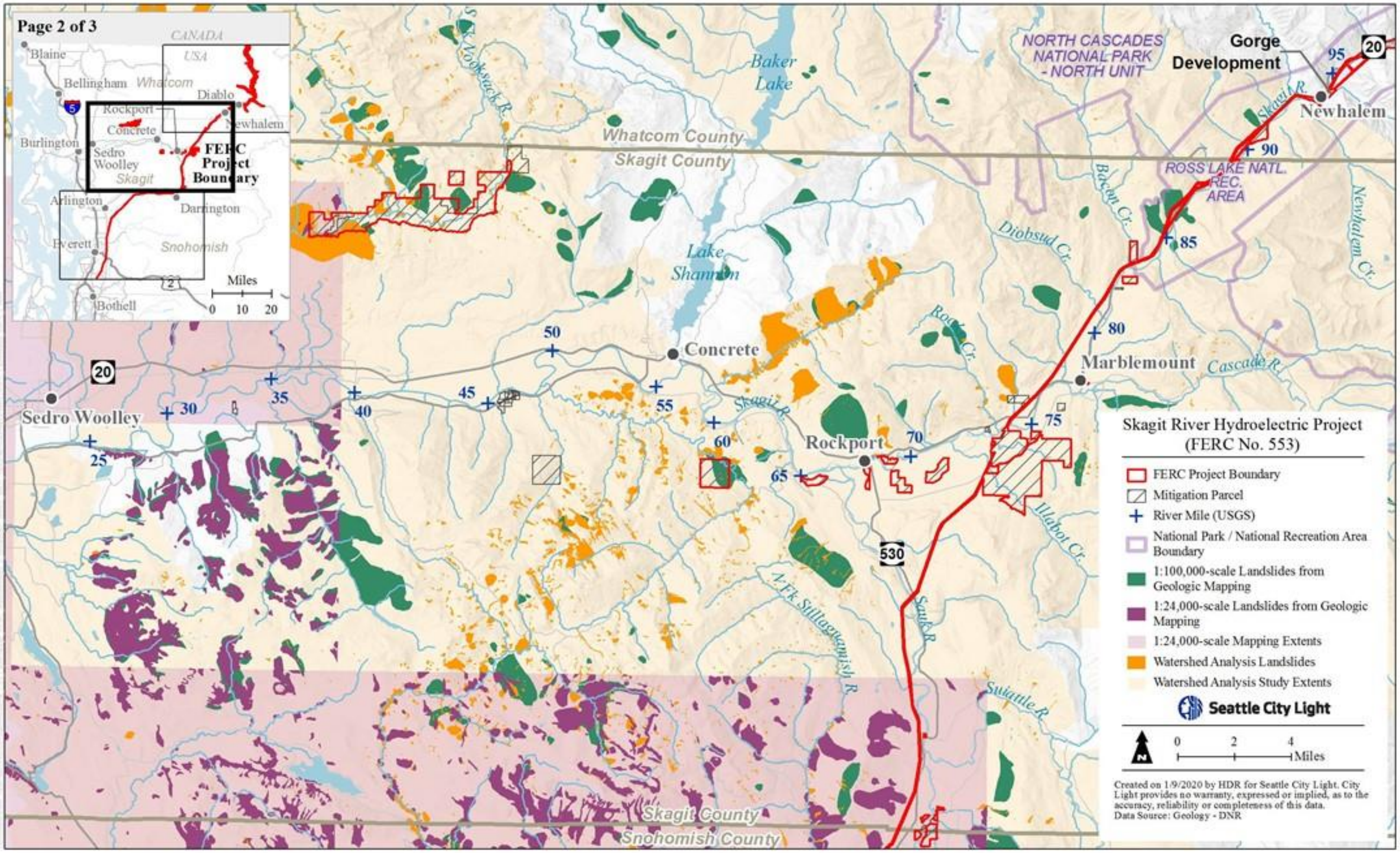


Figure 4.3-3. Landslides in the Project vicinity (page 2 of 3).

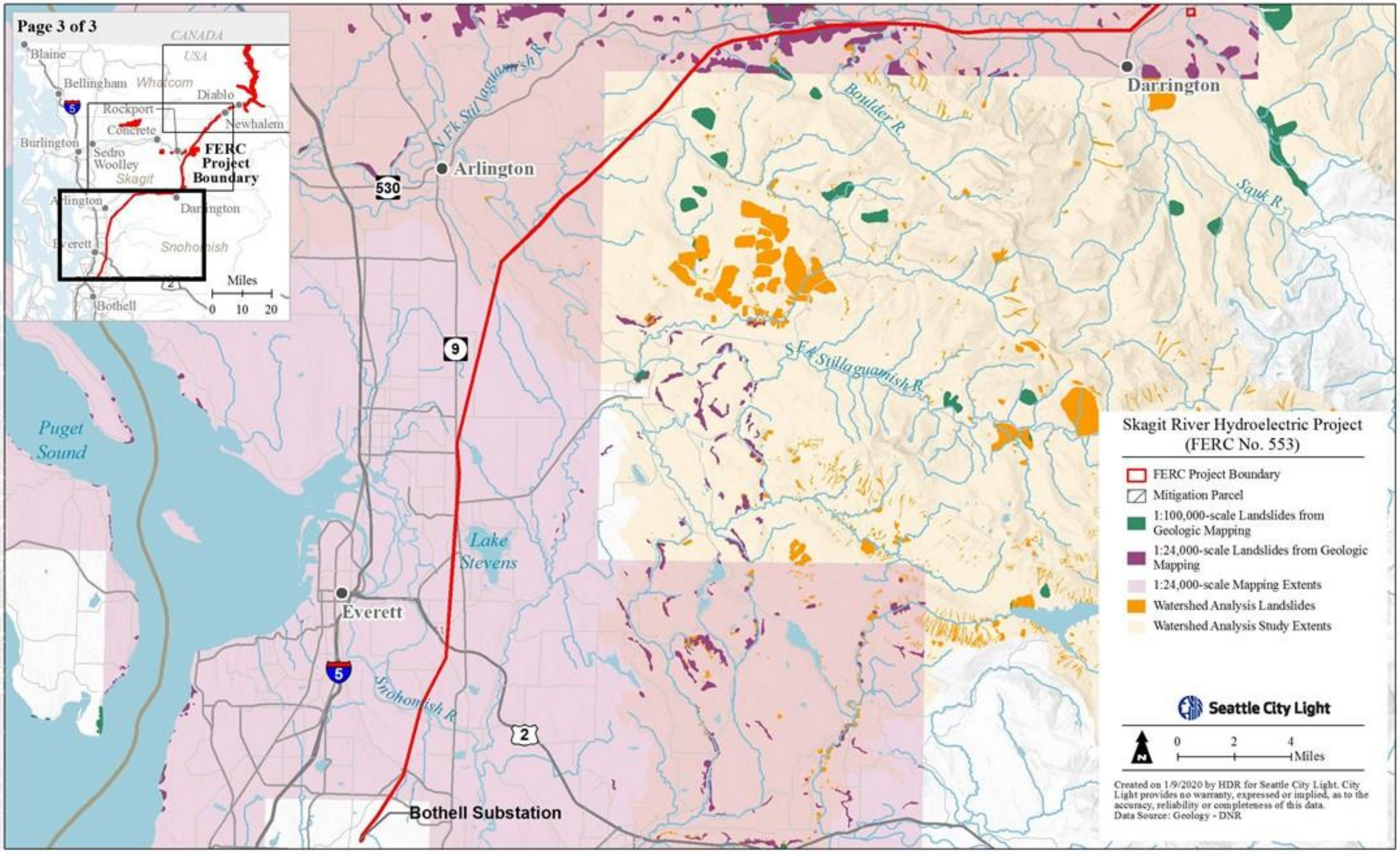


Figure 4.3-3. Landslides in the Project vicinity (page 3 of 3).

4.3.2 Soils

Soils in the Project vicinity reflect the underlying bedrock and landforms they developed on, with primarily thin rocky soil around Project reservoirs and powerhouses and thicker soils in valley bottoms and along the transmission line corridor. Soils in the Project vicinity are shown on Figure 4.3-4 and characteristics within the Project Boundary and fish and wildlife mitigation lands are listed in Tables 4.3-3 and 4.3-4.

Dominant soils around Project reservoirs, dams, and the transmission line corridor down to Bacon Creek include (USDA et al. 2012):

- Tricouni-Ragged-Easy complex, 5 to 50 percent slopes. This soil unit includes 50 percent Tricouni soils, 25 percent Ragged soils, 15 percent Easy soils, and 10 percent other minor components. It forms on debris cones and valley walls from volcanic ash over glacial drift or alluvium, is characterized by gravelly ashy loam and sand, and is very erodible.
- Thorton-Ragged-Damnation complex, 35 to 100 percent slopes. This soil unit includes 40 percent Thorton soils, 25 percent Ragged soils, 15 percent Damnation soils, and 20 percent other minor components. It forms on mountain flanks and valley walls from volcanic ash over glacial drift or alluvium, is characterized by gravelly to cobbly ashy loam and sand, and is very erodible.
- Thorton-Ragged-Ledeir complex, 15 to 65 percent slopes. This soil unit includes 40 percent Thorton soils, 25 percent Ragged soils, 15 percent Ledeir soils, and 20 percent other minor components. It forms on mountain flanks, debris aprons, and valley walls from volcanic ash over glacial drift or alluvium, is characterized by gravelly ashy loam and sand, and is very erodible.
- Roland-Skymo-Deerlick complex, 0 to 25 percent slopes. This soil unit includes 40 percent Roland soils, 25 percent Skymo soils, 20 percent Deerlick soils, and 15 percent other minor components. It forms on fans, terraces, and debris aprons from volcanic ash over glacial drift or alluvium, is characterized by fine sandy loam to loamy sand, and is very erodible.
- Damnation-Ragged-Rock outcrop complex, 35 to 100 percent slopes. This soil unit includes 50 percent Damnation soils, 25 percent Ragged soils, 15 percent rock outcrop, and 10 percent other minor components. It forms on bedrock benches and valley walls from volcanic ash over glacial drift or alluvium, is characterized by cobbly ashy sandy loam and sand or rubble on the rock outcrop areas, and is very erodible.
- Despair-Goode-Rock outcrop complex, 35 to 100 percent slopes. This soil unit includes 40 percent Despair soils, 30 percent Goode soils, 15 percent rock outcrop, and 15 percent other minor components. It forms on bedrock benches, valley walls, and debris aprons from volcanic ash over glacial drift or alluvium, is characterized by gravelly ashy sandy loam or rubble on the rock outcrop areas, and is very erodible.
- Farway-Sawtooth-Despair complex, 35 to 100 percent slopes. This soil unit includes 50 percent Farway soils, 25 percent Sawtooth soils, 15 percent Despair soils, and 10 percent other minor components. It forms on debris aprons, bedrock benches, and valley walls from volcanic ash over colluvium or glacial drift, is characterized by cobbly ashy sandy loam, and is very erodible.

- Manlywham-Nohokomeen-Roland complex, 0 to 5 percent slopes. This soil unit includes 60 percent Manlywam soils, 15 percent Nohokomeen soils, 15 percent Roland soils, and 10 percent other minor components. It forms in depressions and on floodplains and terraces from volcanic ash over alluvium or glacial drift, is characterized by gravelly sandy loam to fine sandy loam, and is slightly erodible.
- Chilliwack-Perfect-Terror complex, 15 to 65 percent slopes. This soil unit includes 40 percent Chilliwack soils, 30 percent Perfect soils, 15 percent Terror soils, and 15 percent other minor components. It forms on debris cones and debris aprons from volcanic ash over coluvium or glacial drift, is characterized by gravelly sandy loam to gravelly loamy sand, and is very erodible.

The transmission line corridor follows river valleys and rolling hills along the Sauk River and North Fork Stillaguamish River valleys to the Puget Lowland and the Bothell Substation. This area contains a mix of soils that include (Debose and Klungland 1983; USDA 2019):

- Tokul gravelly medial loam, 0 to 8 percent slopes. This moderately deep, moderately well drained soil forms on till plains from glacial till and volcanic ash. It is composed of gravelly loam to gravelly fine sandy loam with moderate to low permeability and slight erosion hazard.
- Tokul-Winston gravelly loams, 25 to 65 percent slopes. This soil unit is about 50 percent Tokul gravelly loam and 30 percent Winston gravelly loam with 20 percent other minor components. Soils are moderately deep to very deep and formed on glacial till and outwash with volcanic ash. It is composed of gravelly loam to gravelly fine sandy loam with moderate permeability and slight erosion hazard on Tokul soils and severe erosion hazard on Winston soil areas.
- Barneston gravelly ashy loam, 0 to 8 percent slopes. This soil is very deep, well-drained, formed in volcanic ash and loess over outwash and occurs on glacial outwash terraces and till plains. It is composed of gravelly ashy loam to gravelly sand and has a slight erosion hazard.
- Greenwater loamy sand. This very deep, excessively drained soil forms on low gradient terraces in alluvium derived from andesite and pumice. It is characterized by loamy sand and erosion hazard is slight.

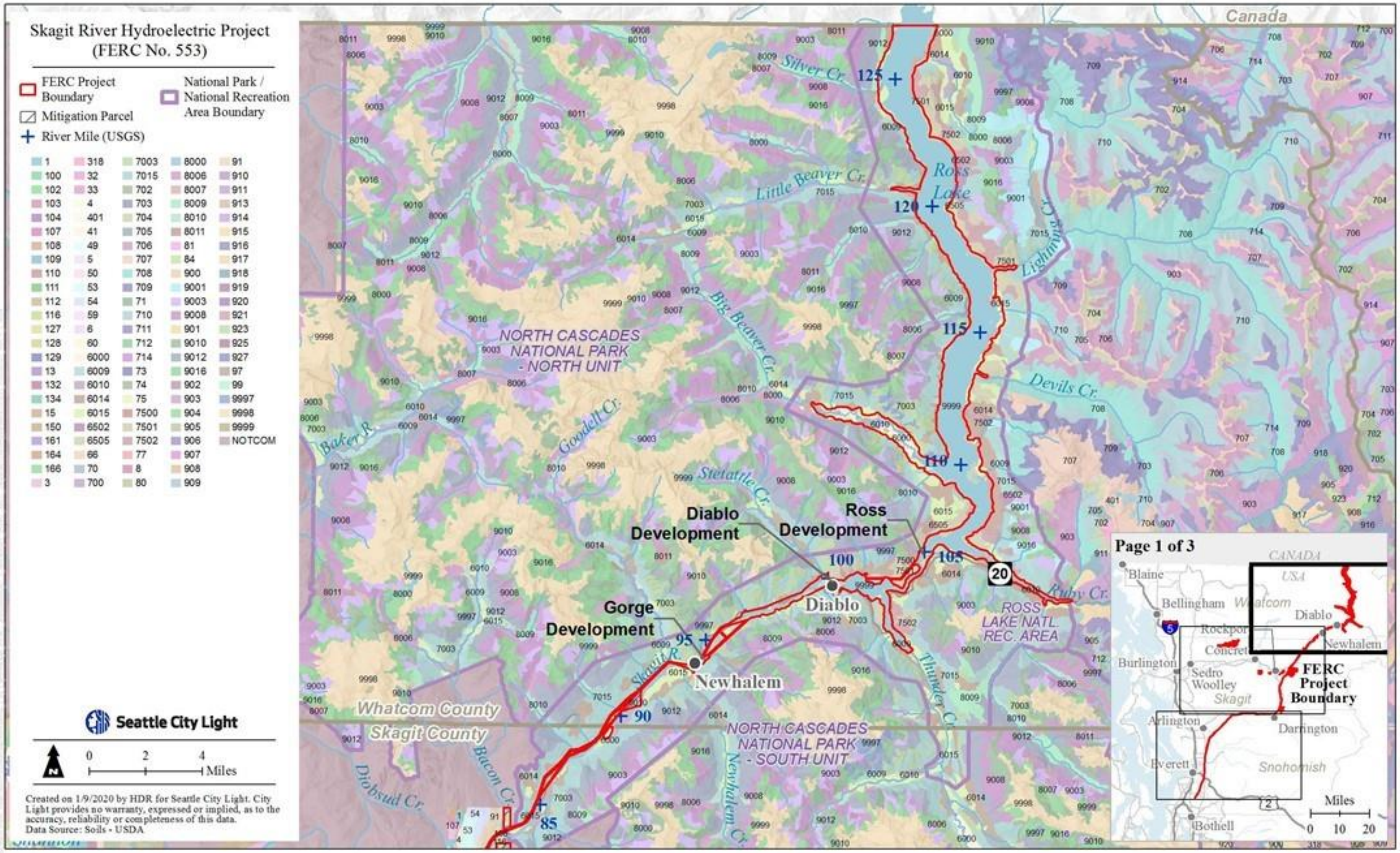


Figure 4.3-4. Soils in the Project vicinity (page 1 of 3).

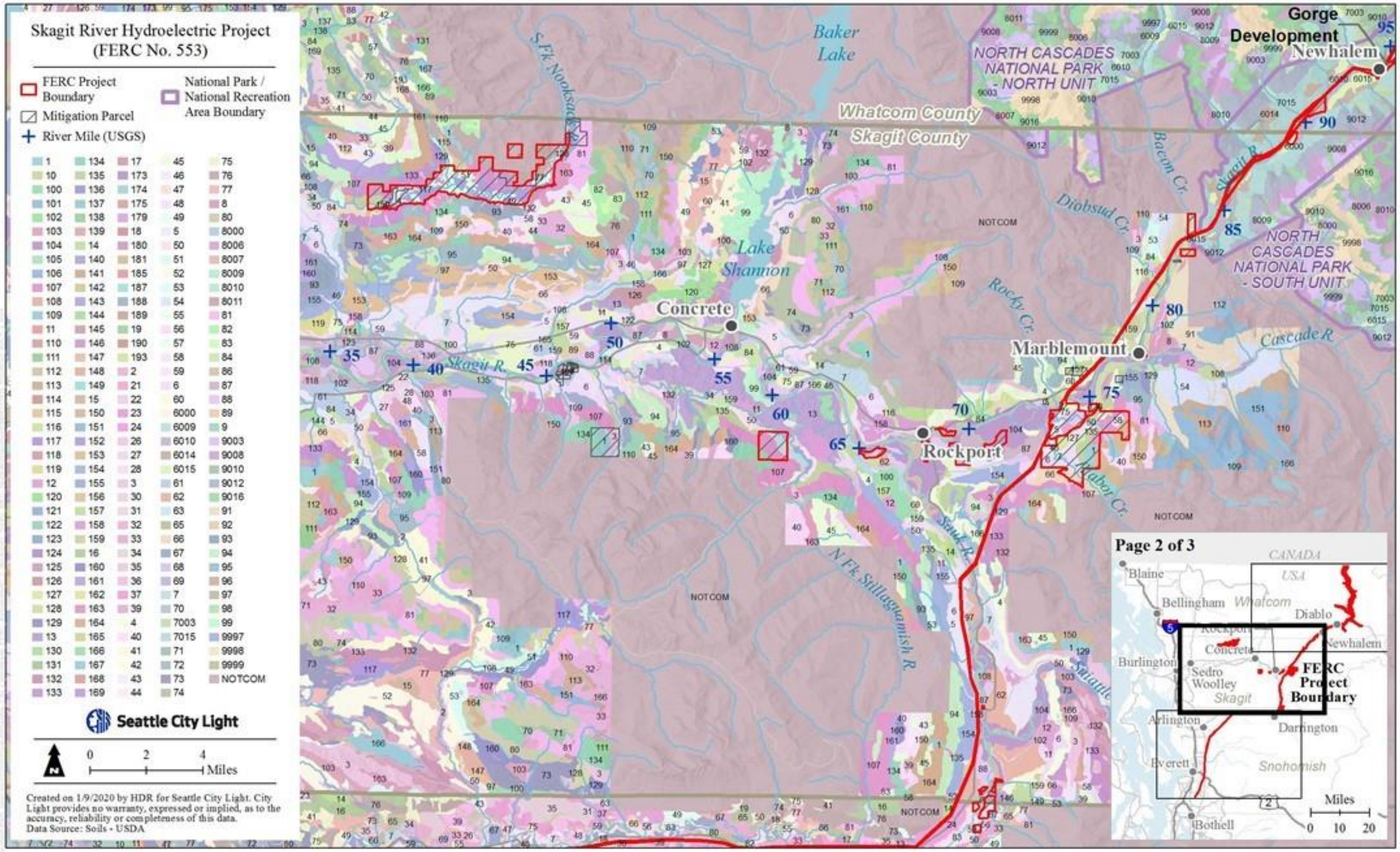


Figure 4.3-4. Soils in the Project vicinity (page 2 of 3).

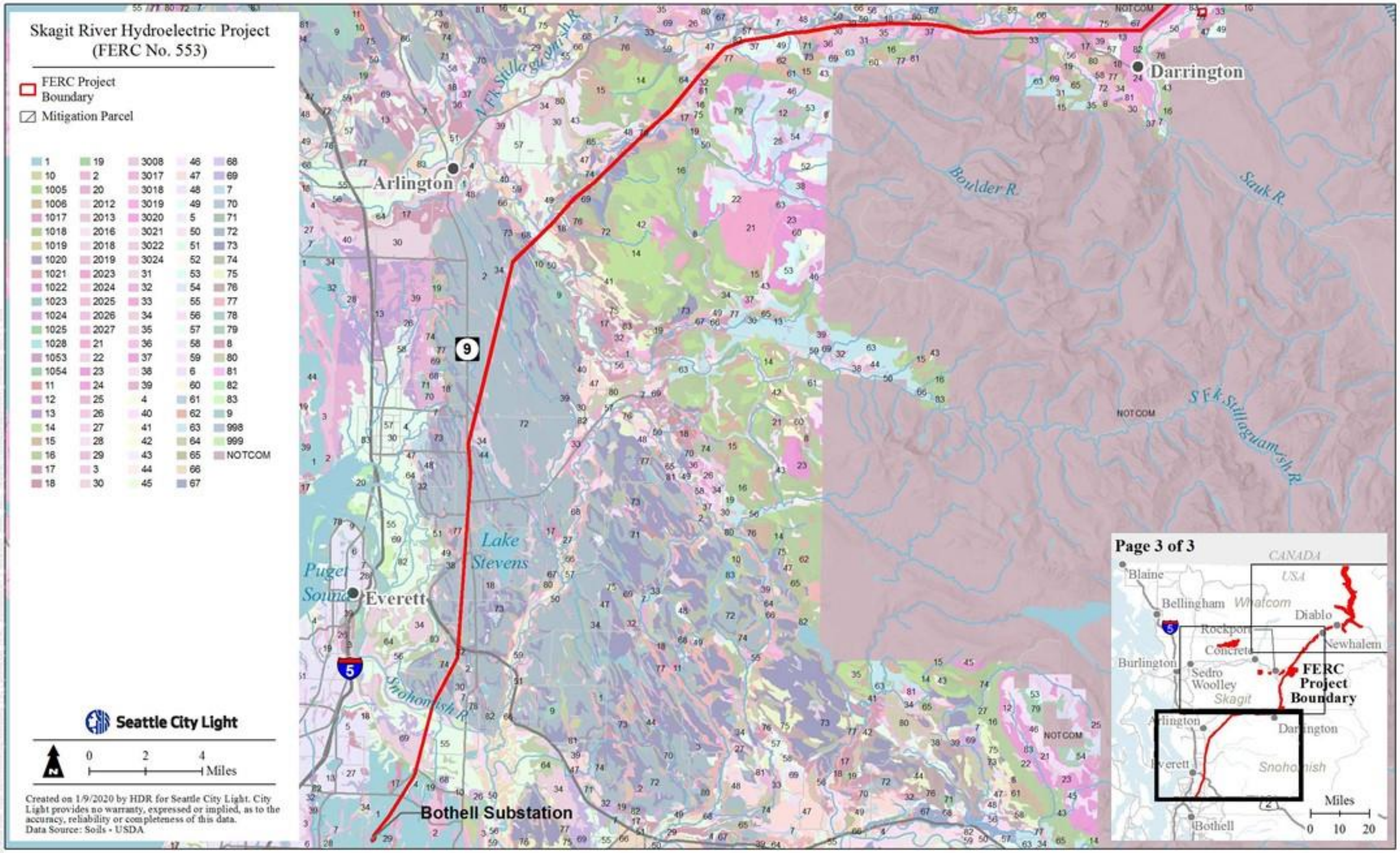


Figure 4.3-4. Soils in the Project vicinity (page 3 of 3).

Table 4.3-3 Soil occurrence and characteristics within the Project Boundary.

Soil Name	Acres	Percent of Area	Average Slope Gradient (%)	Drainage Class	Erosion Potential
Alderwood gravelly sandy loam, 0 to 8 percent slopes	83	0.9%	2	Moderately well drained	Slight
Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes	6	0.1%	48	Moderately well drained	Severe
Andic Xerochrepts, warm-Rock outcrop complex, 65 to 90 percent slopes	6	0.1%	78	Well drained	Severe
Barneston gravelly ashy loam, 0 to 8 percent slopes	147	1.6%	4	Somewhat excessively drained	Slight
Barneston gravelly ashy loam, 30 to 65 percent slopes	11	0.1%	45	Somewhat excessively drained	Severe
Barneston gravelly ashy loam, 8 to 30 percent slopes	26	0.3%	15	Somewhat excessively drained	Moderate
Barneston very cobbly sandy loam, 0 to 8 percent slopes	75	0.8%	4	Somewhat excessively drained	Slight
Bellingham silty clay loam	37	0.4%	2	Poorly drained	Slight
Birdsview loamy sand, 0 to 8 percent slopes	26	0.3%	4	Somewhat excessively drained	Slight
Chilliwack-Perfect-Terror complex, 15 to 65 percent slopes	110	1.2%	35	Well drained	Severe
Custer fine sandy loam	19	0.2%	1	Poorly drained	Slight
Damnation-Ragged-Rock outcrop complex, 35 to 100 percent slopes	377	4.0%	75	Well drained	Severe
Despair-Goode-Rock outcrop complex, 35 to 100 percent slopes	768	8.1%	65	Well drained	Severe
Dystric Xerochrepts, 45 to 70 percent slopes	8	0.1%	58	Well drained	Severe
Dystric Xerorthents, 50 to 80 percent slopes	31	0.3%	65	Excessively drained	Severe
Everett very gravelly sandy loam, 0 to 8 percent slopes	37	0.4%	5	Somewhat excessively drained	Slight
Everett very gravelly sandy loam, 8 to 15 percent slopes	19	0.2%	10	Somewhat excessively drained	Moderate
Farway-Lyall-Inspiration complex, 5 to 65 percent slopes	104	1.1%	35	Well drained	Severe
Farway-Sawtooth-Despair complex, 35 to 100 percent slopes	526	5.6%	65	Well drained	Severe
Giles variant silt loam	72	0.8%	2	Well drained	Slight
Greenwater loamy sand	140	1.5%	2	Somewhat excessively drained	Slight
Greenwater sandy loam	68	0.7%	2	Somewhat excessively drained	Slight
Indianola loamy sand, 0 to 5 percent slopes	12	0.1%	3	Somewhat excessively drained	Slight

Soil Name	Acres	Percent of Area	Average Slope Gradient (%)	Drainage Class	Erosion Potential
Indianola loamy sand, 15 to 30 percent slopes	6	0.1%	20	Somewhat excessively drained	Severe
Larush silt loam	19	0.2%	2	Well drained	Slight
Lynnwood loamy sand, 0 to 3 percent slopes	11	0.1%	2	Somewhat excessively drained	Slight
Lynnwood-Nargar complex, 65 to 90 percent slopes	7	0.1%	78	Somewhat excessively drained	Severe
Manlywham-Nohokomeen-Roland complex, 0 to 5 percent slopes	393	4.2%	1	Poorly drained	Slight
Marblemount-Rock outcrop complex, 65 to 90 percent slopes	28	0.3%	78	Well drained	Severe
Menzel silt loam, 0 to 3 percent slopes	90	1.0%	2	Well drained	Slight
Mesahchie-Inspiration-Lyall complex, 15 to 65 percent slopes	93	1.0%	35	Well drained	Severe
Montborne very gravelly silt loam, 3 to 30 percent slopes	15	0.2%	17	Moderately well drained	Severe
Mukilteo muck	59	0.6%	1	Very poorly drained	Slight
Nargar fine sandy loam, 0 to 15 percent slopes	44	0.4%	8	Well drained	Moderate
Nargar-Lynnwood complex, 30 to 65 percent slopes	38	0.4%	48	Well drained	Severe
Norma loam	56	0.6%	2	Poorly drained	Slight
Pastik silt loam, 0 to 8 percent slopes	38	0.4%	4	Moderately well drained	Moderate
Pastik silt loam, 25 to 50 percent slopes	14	0.1%	38	Moderately well drained	Severe
Pastik silt loam, 8 to 25 percent slopes	11	0.1%	17	Moderately well drained	Severe
Pilchuck loamy sand	22	0.2%	2	Excessively drained	Slight
Puget silty clay loam	25	0.3%	1	Poorly drained	Slight
Puyallup fine sandy loam	8	0.1%	2	Well drained	Slight
Ragged-Tricouni-Cosho complex, 15 to 65 percent slopes	297	3.1%	35	Well drained	Severe
Ragnar fine sandy loam, 0 to 8 percent slopes	13	0.1%	4	Well drained	Moderate
Ragnar fine sandy loam, 8 to 15 percent slopes	7	0.1%	12	Well drained	Severe
Rinker very channery loam, 30 to 65 percent slopes	17	0.2%	48	Well drained	Severe
Riverwash	25	0.3%	2	Somewhat excessively drained	Not rated
Rock outcrop	7	0.1%	75	n/a	Not rated
Rock outcrop-Despair complex, 35 to 100 percent slopes	13	0.1%	90	n/a	Not rated
Roland-Skymo-Deerlick complex, 0 to 25 percent slopes	510	5.4%	10	Moderately well drained	Severe

Soil Name	Acres	Percent of Area	Average Slope Gradient (%)	Drainage Class	Erosion Potential
Sauk silt loam	12	0.1%	2	Well drained	Slight
Skykomish very gravelly loam, 0 to 8 percent slopes	33	0.3%	4	Somewhat excessively drained	Slight
Snohomish silt loam	10	0.1%	1	Poorly drained	Slight
Sorensen very gravelly silt loam, 3 to 30 percent slopes	33	0.4%	17	Well drained	Severe
Spickard-Tepeh-Maggib complex, 15 to 100 percent slopes	13	0.1%	75	Well drained	Severe
Squires very gravelly silt loam, 30 to 65 percent slopes	13	0.1%	48	Well drained	Severe
Sulsavar gravelly loam, 0 to 8 percent slopes	26	0.3%	4	Well drained	Slight
Sultan variant silt loam	14	0.2%	2	Well drained	Slight
Terric Medisaprists, nearly level	18	0.2%	2	Very poorly drained	Slight
Thorton-Ragged-Damnation complex, 35 to 100 percent slopes	967	10.2%	65	Well drained	Severe
Thorton-Ragged-Ledeir complex, 15 to 65 percent slopes	1,362	14.4%	35	Well drained	Severe
Tokul gravelly medial loam, 0 to 8 percent slopes	341	3.6%	2	Moderately well drained	Slight
Tokul gravelly medial loam, 15 to 30 percent slopes	44	0.5%	20	Moderately well drained	Severe
Tokul gravelly medial loam, 8 to 15 percent slopes	141	1.5%	10	Moderately well drained	Moderate
Tokul silt loam, 2 to 8 percent slopes	17	0.2%	5	Moderately well drained	Moderate
Tokul-Ogarty-Rock outcrop complex, 25 to 65 percent slopes	36	0.4%	45	Moderately well drained	Severe
Tokul-Winston gravelly loams, 25 to 65 percent slopes	126	1.3%	45	Moderately well drained	Severe
Tricouni-Ragged-Easy complex, 5 to 50 percent slopes	1475	15.6%	25	Well drained	Severe
Vanzandt very gravelly loam, 15 to 30 percent slopes	29	0.3%	23	Moderately well drained	Severe
Winston gravelly loam, 0 to 3 percent slopes	29	0.3%	2	Somewhat excessively drained	Slight
Winston gravelly silt loam, 0 to 8 percent slopes	83	0.9%	4	Well drained	Slight
Wiseman channery sandy loam, 0 to 8 percent slopes	22	0.2%	4	Somewhat excessively drained	Slight

Source: USDA 2019.

The Project fish and wildlife mitigation lands include parcels within the Skagit, Sauk, and South Fork Nooksack watersheds that are managed for wildlife and aquatic habitat resources. Soils within the mitigation lands are listed in Table 4.3-4.

Major soil types on the mitigation lands include (Klungland and McArthur 1989):

- Dystric Xerorthents, cool, 60 to 90 percent slopes. This soil is very deep, well-drained, and formed predominantly on glacial till or outwash. It is composed of gravelly sandy loam to loamy sand and has a severe erosion hazard due to the steep slopes.
- Jackman gravelly loam, 30 to 65 percent slopes. This very deep, well-drained soil forms on mountainsides in colluvium containing volcanic ash and glacial till. It is composed of gravelly loam to gravelly sandy loam and has severe erosion hazard.
- Pilchuck loamy sand. This soil is very deep, somewhat excessively drained, and forms on floodplains. It is composed of river floodplain deposits and is loamy sand to gravelly loam. Erosion hazard is slight.
- Rinker very channery loam, 30 to 65 percent slopes. This soil is moderately deep, well drained, and forms on mountainsides from volcanic ash, glacial till, and colluvium derived from underlying phyllite. Texture ranges from very channery loam to silt loam and has severe erosion hazard.
- Saxon silt loam, 0 to 30 percent slopes. This soil is moderately well drained and forms on hills and terraces in areas of volcanic ash underlain by glaciolacustrine sediments. It includes silt loam to silty clay loam and erosion hazard is severe.
- Squires very gravelly silt loam, 30 to 65 percent slopes. This moderately deep, well-drained soil forms on mountainsides in colluvium derived from underlying phyllite, ash, and glacial till. Texture ranges from gravelly silt loam to gravelly loam. Erosion hazard is severe.

Table 4.3-4 Soil occurrence and characteristics in the Project fish and wildlife mitigation lands.

Soil Name	South Fork Nooksack watershed		Sauk River watershed		Skagit River watershed downstream from Sauk River confluence		Skagit River watershed upstream from Sauk River confluence		Average slope gradient (%)	Drainage Class	Erosion Potential
	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area			
Andic Cryochrepts-Rock outcrop complex, 65 to 90 percent slopes	0	0.0%	0	0.0%	280	17.1%	187	4.4%	78	Well drained	Severe
Andic Xerochrepts, warm-Rock outcrop complex, 65 to 90 percent slopes	39	0.9%	0	0.0%	0	0.0%	58	1.4%	78	Well drained	Severe
Andic Xerochrepts-Rock outcrop complex, 65 to 90 percent slopes	209	4.7%	0	0.0%	206	12.6%	47	1.1%	78	Well drained	Severe
Barneston gravelly ashy loam, 0 to 8 percent slopes	2	0.0%	0	0.0%	0	0.0%	437	10.3%	3.9	Somewhat excessively drained	Slight
Barneston gravelly ashy loam, 30 to 65 percent slopes	0	0.0%	0	0.0%	186	11.4%	48	1.1%	42.9	Somewhat excessively drained	Severe
Barneston gravelly ashy loam, 8 to 30 percent slopes	0	0.0%	0	0.0%	1	0.0%	347	8.2%	14.4	Somewhat excessively drained	Moderate
Barneston very cobbly sandy loam, 0 to 8 percent slopes	0	0.0%	0	0.0%	0	0.0%	17	0.4%	4	Somewhat excessively drained	Slight
Birdsview loamy sand, 0 to 8 percent slopes	0	0.0%	0	0.0%	0	0.0%	108	2.6%	4	Somewhat excessively drained	Slight
Birdsview loamy sand, 50 to 80 percent slopes	0	0.0%	0	0.0%	25	1.6%	0	0.0%	63.1	Somewhat excessively drained	Severe
Cokedale silt loam	103	2.3%	0	0.0%	17	1.0%	0	0.0%	2	Somewhat poorly drained	Slight
Crinker-Rock outcrop complex, 30 to 65 percent slopes	0	0.0%	0	0.0%	0	0.0%	8	0.2%	48	Well drained	Severe
Dystric Xerochrepts, 45 to 70 percent slopes	0	0.0%	0	0.0%	0	0.0%	39	0.9%	58	Well drained	Severe

Soil Name	South Fork Nooksack watershed		Sauk River watershed		Skagit River watershed downstream from Sauk River confluence		Skagit River watershed upstream from Sauk River confluence		Average slope gradient (%)	Drainage Class	Erosion Potential
	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area			
Dystric Xerorthents, 0 to 5 percent slopes	241	5.5%	0	0.0%	0	0.0%	0	0.0%	3	Excessively drained	Slight
Dystric Xerorthents, 50 to 80 percent slopes	0	0.0%	0	0.0%	3	0.2%	197	4.6%	65	Excessively drained	Severe
Dystric Xerorthents, cool, 60 to 90 percent slopes	672	15.2%	0	0.0%	0	0.0%	0	0.0%	75	Moderately well drained	Severe
Etach very gravelly sandy loam, 30 to 65 percent slopes	0	0.0%	0	0.0%	0	0.0%	2	0.0%	48	Somewhat excessively drained	Severe
Getchell gravelly silt loam, 30 to 65 percent slopes	0	0.0%	0	0.0%	0	0.0%	79	1.9%	48	Moderately well drained	Severe
Giles silt loam	0	0.0%	0	0.0%	0	0.0%	16	0.4%	2	Well drained	Slight
Gilligan silt loam	0	0.0%	0	0.0%	92	5.7%	0	0.0%	2	Well drained	Slight
Greenwater sandy loam	0	0.0%	0	0.0%	12	0.8%	0	0.0%	2	Somewhat excessively drained	Slight
Heisler gravelly silt loam, 30 to 65 percent slopes	0	0.0%	0	0.0%	0	0.0%	159	3.8%	48	Well drained	Severe
Indianola loamy sand, 0 to 5 percent slopes	0	0.0%	0	0.0%	0	0.0%	141	3.3%	3	Somewhat excessively drained	Slight
Jackman gravelly loam, 30 to 65 percent slopes	519	11.8%	0	0.0%	0	0.0%	0	0.0%	48	Well drained	Severe
Jug very gravelly loam, 0 to 30 percent slopes	115	2.6%	0	0.0%	0	0.0%	0	0.0%	15	Somewhat excessively drained	Moderate
Kindy gravelly silt loam, 30 to 65 percent slopes	162	3.7%	0	0.0%	0	0.0%	18	0.4%	48	Moderately well drained	Severe
	0	0.0%	0	0.0%	0	0.0%	5	0.1%			
Larush fine sandy loam	0	0.0%	6	1.7%	77	4.7%	119	2.8%	3	Well drained	Moderate
Larush silt loam	0	0.0%	0	0.1%	50	3.0%	261	6.2%	2	Well drained	Slight

Soil Name	South Fork Nooksack watershed		Sauk River watershed		Skagit River watershed downstream from Sauk River confluence		Skagit River watershed upstream from Sauk River confluence		Average slope gradient (%)	Drainage Class	Erosion Potential
	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area			
Manlywham-Nohokomeen-Roland complex, 0 to 5 percent slopes	0	0.0%	0	0.0%	0	0.0%	50	1.2%	1.6	Poorly drained	Slight
Marblemount-Rock outcrop complex, 65 to 90 percent slopes	0	0.0%	0	0.0%	0	0.0%	2	0.1%	78	Well drained	Severe
Montborne very gravelly loam, 30 to 65 percent slopes	105	2.4%	0	0.0%	0	0.0%	0	0.0%	48	Moderately well drained	Severe
Montborne-Rinker complex, 30 to 65 percent slopes	85	1.9%	0	0.0%	0	0.0%	0	0.0%	48	Moderately well drained	Severe
No Digital Data Available	161	3.7%	0	0.0%	3	0.2%	39	0.9%	<Null>	<Null>	Not rated
Norma loam	0	0.0%	14	4.3%	0	0.0%	0	0.0%	2	Poorly drained	Slight
Norma silt loam	0	0.0%	6	1.8%	0	0.0%	0	0.0%	2	Poorly drained	Slight
Pilchuck loamy sand	0	0.0%	193	59.4%	102	6.2%	341	8.1%	2	Somewhat excessively drained	Slight
Puyallup fine sandy loam	0	0.0%	60	18.3%	0	0.0%	0	0.0%	2	Well drained	Slight
Rinker very channery loam, 30 to 65 percent slopes	456	10.3%	0	0.0%	356	21.8%	263	6.2%	48	Well drained	Severe
Riverwash	0	0.0%	46	14.2%	0	0.0%	69	1.6%	2	<Null>	Not rated
Rock outcrop	14	0.3%	0	0.0%	0	0.0%	11	0.3%	75	<Null>	Not rated
Roland-Skymo-Deerlick complex, 0 to 25 percent slopes	0	0.0%	0	0.0%	0	0.0%	88	2.1%	8.2	Somewhat poorly drained	Severe
Sandun very gravelly sandy loam, 30 to 65 percent slopes	5	0.1%	0	0.0%	0	0.0%	0	0.0%	48	Well drained	Severe
Sauk silt loam	0	0.0%	0	0.0%	12	0.8%	106	2.5%	2	Well drained	Slight
Saxon silt loam, 0 to 30 percent slopes	733	16.6%	0	0.0%	0	0.0%	0	0.0%	15	Moderately well drained	Severe
Skiyou gravelly silt loam, 15 to 30 percent slopes	0	0.0%	0	0.0%	0	0.0%	175	4.1%	23	Well drained	Severe

Soil Name	South Fork Nooksack watershed		Sauk River watershed		Skagit River watershed downstream from Sauk River confluence		Skagit River watershed upstream from Sauk River confluence		Average slope gradient (%)	Drainage Class	Erosion Potential
	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area			
Skykomish very gravelly loam, 0 to 8 percent slopes	131	3.0%	0	0.0%	0	0.0%	0	0.0%	4	Somewhat excessively drained	Slight
Skykomish very gravelly sandy loam, 30 to 65 percent slopes	18	0.4%	0	0.0%	0	0.0%	0	0.0%	48	Somewhat excessively drained	Severe
Sorensen very gravelly silt loam, 30 to 65 percent slopes	520	11.8%	0	0.0%	0	0.0%	0	0.0%	48	Well drained	Severe
Springsteen very gravelly loam, 30 to 65 percent slopes	0	0.0%	0	0.0%	191	11.7%	0	0.0%	48	Well drained	Severe
Squires very gravelly silt loam, 30 to 65 percent slopes	115	2.6%	0	0.0%	15	0.9%	386	9.1%	48	Well drained	Severe
Sultan variant silt loam	0	0.0%	1	0.3%	0	0.0%	0	0.0%	2	Well drained	Slight
Sumas silt loam	0	0.0%	0	0.0%	0	0.0%	123	2.9%	2	Poorly drained	Slight
Thorton-Ragged-Damnation complex, 35 to 100 percent slopes	0	0.0%	0	0.0%	0	0.0%	23	0.6%	61.5	Well drained	Severe
Tricouni-Ragged-Easy complex, 5 to 50 percent slopes	0	0.0%	0	0.0%	0	0.0%	31	0.7%	21.5	Well drained	Severe
Typic Cryorthods-Rock outcrop complex, 65 to 90 percent slopes	0	0.0%	0	0.0%	0	0.0%	199	4.7%	78	Moderately well drained	Severe
Vanzandt very gravelly loam, 0 to 15 percent slopes	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	Moderately well drained	Severe
Vanzandt very gravelly loam, 30 to 65 percent slopes	0	0.0%	0	0.0%	0	0.0%	23	0.5%	48	Moderately well drained	Severe
Winston gravelly silt loam, 0 to 8 percent slopes	0	0.0%	0	0.0%	0	0.0%	1	0.0%	4	Well drained	Slight
Wiseman channery sandy loam, 0 to 8 percent slopes	7	0.2%	0	0.0%	3	0.2%	9	0.2%	4	Somewhat excessively drained	Slight
Wollard-Springsteen complex, 30 to 65 percent slopes	0	0.0%	0	0.0%	0	0.0%	4	0.1%	48	Moderately well drained	Severe

Soil Name	South Fork Nooksack watershed		Sauk River watershed		Skagit River watershed downstream from Sauk River confluence		Skagit River watershed upstream from Sauk River confluence		Average slope gradient (%)	Drainage Class	Erosion Potential
	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area			
Total	**4,412**		**326**		**1,632**		**4,239**				

Source: USDA 2019.

4.3.3 Landforms

Landforms have been mapped by NPS for areas within RLNRA (Riedel et al. 2012). Landform mapping provides information on surficial geologic features and processes by grouping areas of the landscape into units formed by discrete geologic processes. Landforms include features that are depositional in nature (e.g., moraines, alluvial fans) or erosional (horns, bedrock benches). Mapped landforms are shown on Figure 4.3-5, with landform information presented in Table 4.3- 5.

Table 4.3-5. Landform information for RLNRA.

Landform Type	Acres	Percent of Watershed
Alluvial Fan	1,575	1.41
Arete	78	0.07
Bedrock Bench	1,997	1.79
Cirque	712	0.64
Debris Apron	12,323	11.02
Debris Cone	3,220	2.88
Fan Terrace	168	0.15
Floodplain	8,765	7.84
Horn	45	0.04
Little Ice Age Moraine	4	0.00
Mass Movement_debris Avalanche	3,050	2.73
Mass Movement_fall/topple	491	0.03
Mass Movement_slump/creep	9	0.44
Mass Movement_debris Torrent	32	0.01
Other Mountain	9	0.01
Pass	30	0.03
Pleistocene Moraine	417	0.37
Ridge	654	0.58
River Canyon	4,165	3.72
Terrace	2,083	1.86
Valley Bottom	217	0.19
Valley Wall	71,803	64.19

Source: Riedel et al. 2012.

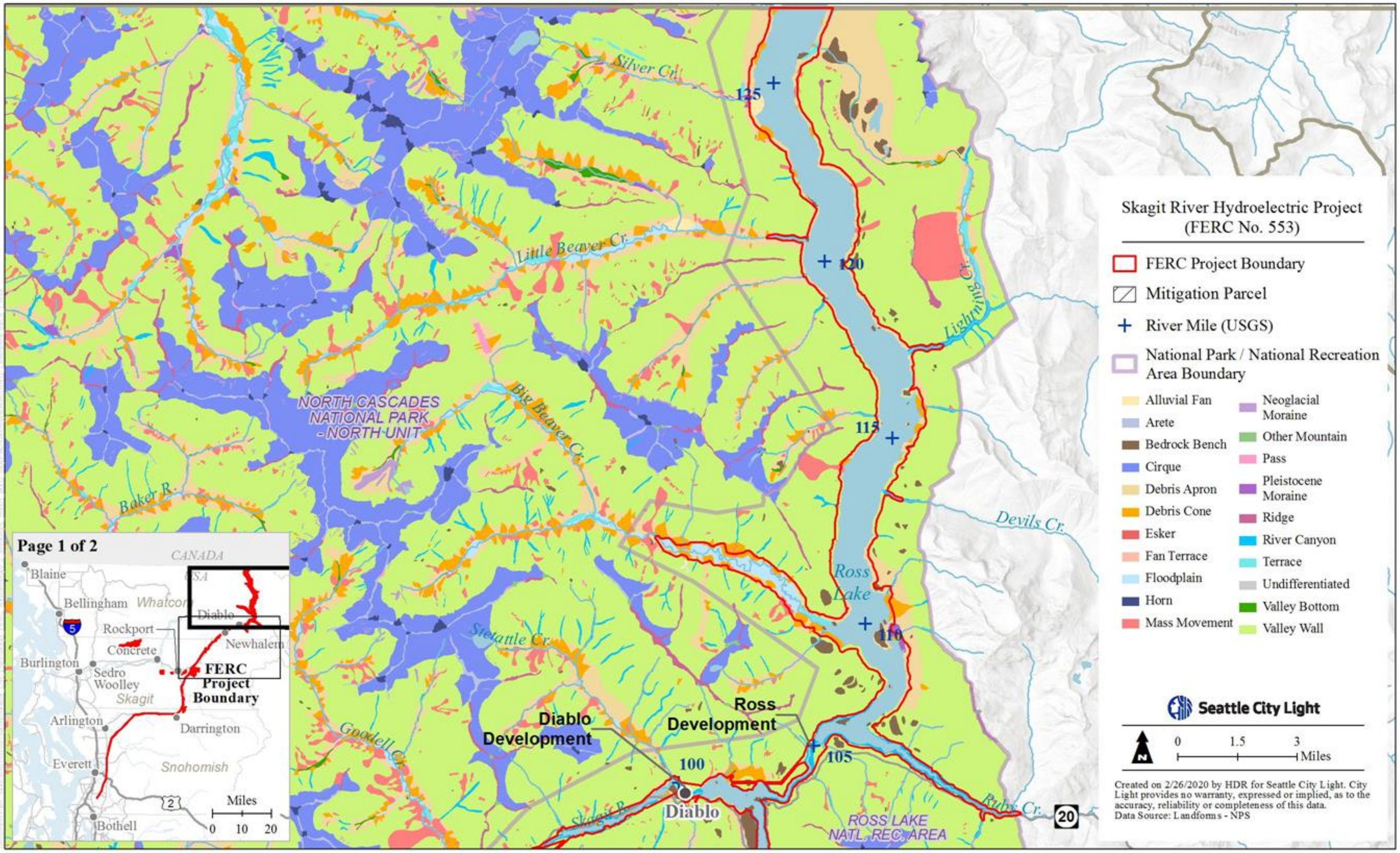


Figure 4.3-5. **Landforms of the Project vicinity in the North Cascades National Park area (page 1 of 2).**

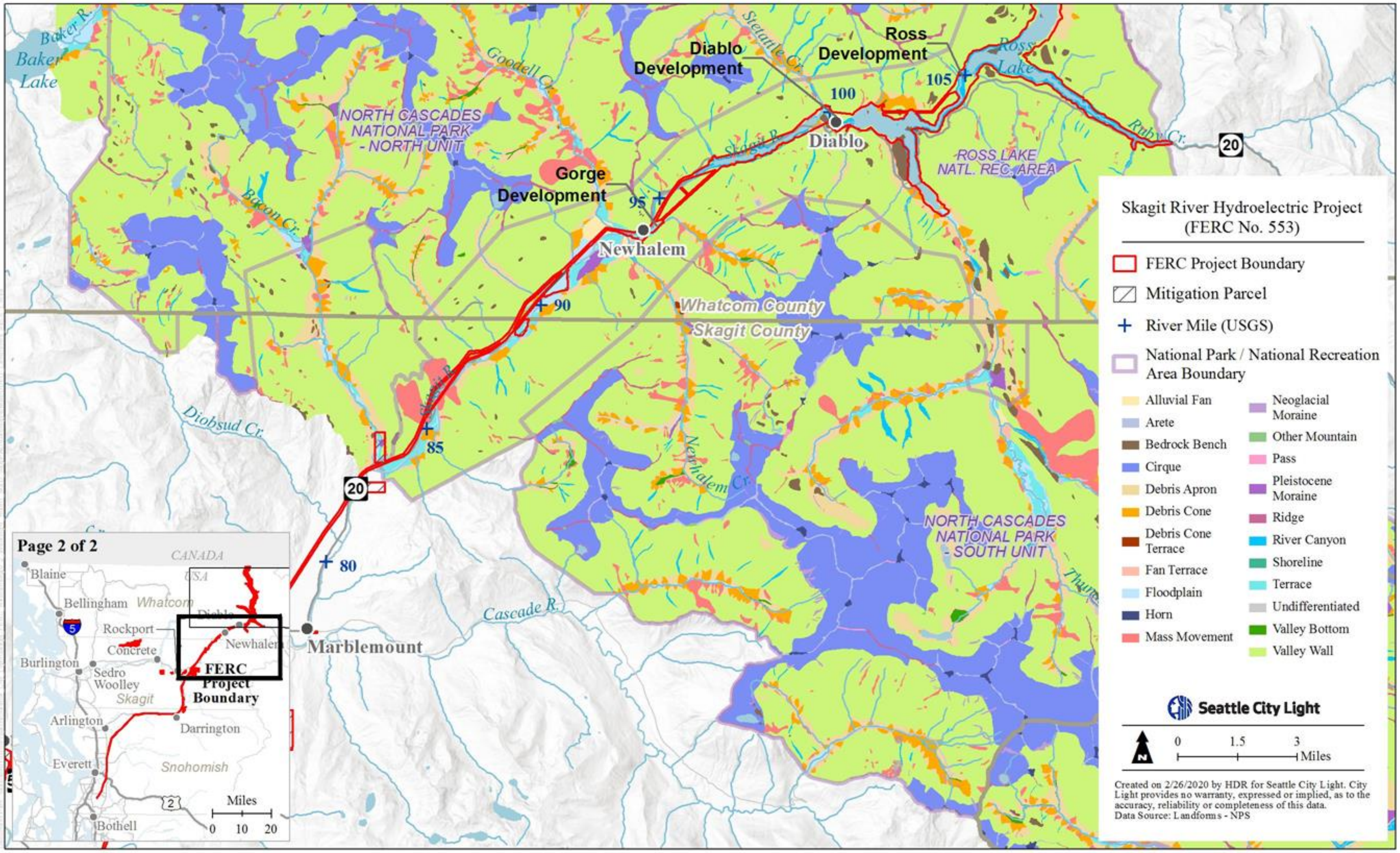


Figure 4.3-5. Landforms of the Project vicinity in the North Cascades National Park area (page 2 of 2).

Watersheds on the western side of Ross Lake include 56 percent valley wall and 13 percent high elevation cirque, with less than 1 percent riparian areas (floodplain, valley bottom, and alluvial fan). The main stem of both the Big and Little Beaver Creek are classic U-shaped glacial valleys with a flat valley bottom, straight profile, and low gradient. Other glacial characteristics of the valleys include oversteepened valley walls, hanging tributary valleys, and truncated valley spurs. Mass movement landforms cover three percent of the landscape, with debris avalanches delivering sediment to streams.

Watersheds to the east of Ross Lake include 58 percent valley wall and 2 percent river canyon, reflecting the steep and narrow nature of the V-shaped east side tributaries. Lightning Creek is an example of glacial rearrangement of the drainage network due to the advance/retreat of the Cordilleran Ice Sheet. On the east side of Ross Lake, mass movements constitute three percent of the landforms. The glacially over-steepened valley walls, erosion on the north-facing slopes, and structural weakness associated with faults and hydrothermal alternation are likely responsible for the majority of mass movement avalanches and rock falls throughout the area.

4.3.4 Reservoir Shoreline and Streambank Conditions

4.3.4.1 Reservoir Shorelines

An inventory of shoreline conditions was completed for the current Project license (Riedel 1990). Shorelines along the three Project reservoirs (Ross, Diablo, and Gorge lakes) are composed of a variety of materials based on the underlying geology and soils materials (Table 4.3-6). The majority of shoreline length on all three reservoirs consists of stable bedrock and talus as well as stable SR 20 road fill along Gorge Lake. Colluvium comprises another large portion of lake shorelines and can be unstable on steep slopes, but is thin, resulting in limited erosion volumes. Glacial till along the shorelines of Ross and Diablo lakes is generally consolidated and stable, but in some areas the till is unconsolidated and erodible. Less stable deposits (outwash, unconsolidated areas of alluvial fan, alluvium, and landslide deposits) are subject to erosion.

Table 4.3-6. Length (ft) and percentage of shoreline composed of various materials.

Material	Ross Lake	Diablo Lake	Gorge Lake
Bedrock	95,670 (33%)	38,090 (48%)	19,195 (40%)
Talus	18,440 (6%)	5,250 (7%)	8,365 (17%)
Colluvium	56,675 (20%)	8,990 (11%)	1,970 (4%)
Undifferentiated	0	985 (1%)	655 (1%)
Glacial Till	67,750 (23%)	8,840 (12%)	0
Outwash	8,675 (3%)	0	0
Alluvial Fan	28,740 (10%)	8,775 (11%)	7,710 (16%)
Alluvium	2,295 (<1%)	1,805 (2%)	1,970 (4%)
Landslide	2,625 (<1%)	0	0
Fill	5,415 (2%)	6,238 (8%)	8,040 (17%)
Total	**286,285**	**78,973**	**47,905**

Source: Riedel 1990.

Lake shorelines are subject to erosion from waves, currents, freeze-thaw action, mass movements, and groundwater and overland flow. Manipulation of reservoir levels contributes to lake shoreline erosion by focusing wave energy on different parts of the bank and exposing areas within the drawdown zone to wave action, freeze-thaw, and overland flow. During reservoir drawdown and filling, previously material eroded is transported downslope and deposited in lower elevations of the reservoirs.

Ross Lake is drawn down seasonally up to 120 feet for flood control storage and to capture spring runoff (Figure 4.3-6). As a result, areas within the Ross Lake drawdown zone are subject to subaerial erosion processes and intermittent wave erosion.

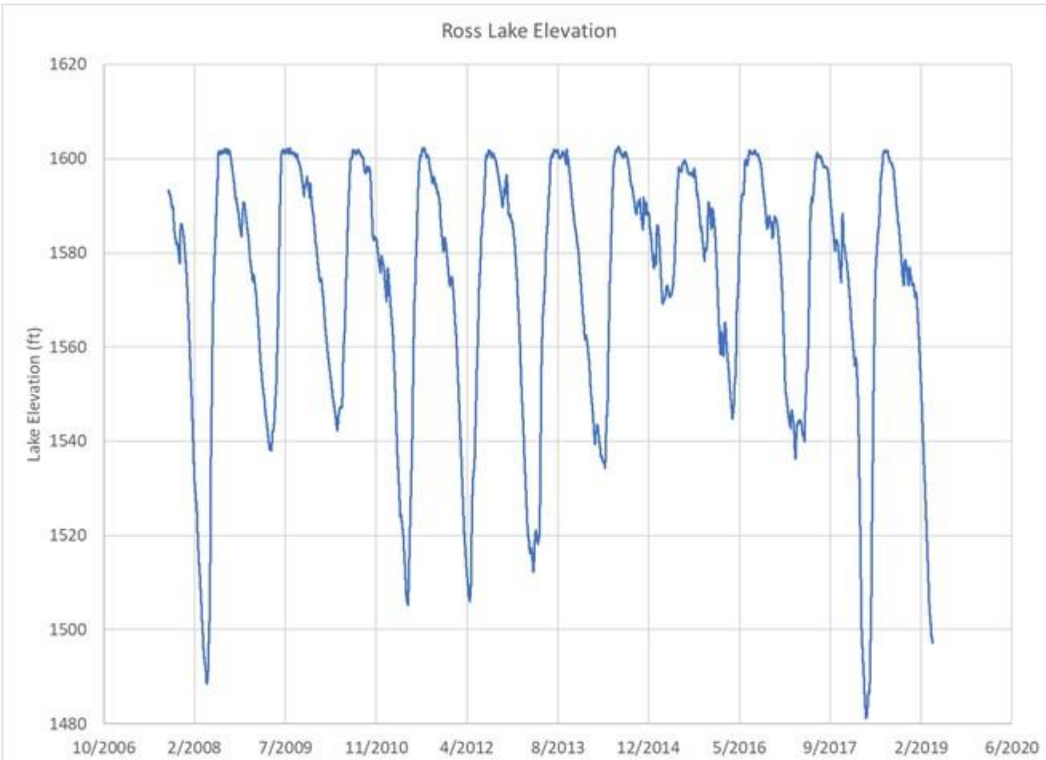


Figure 4.3-6. Ross Lake elevation, 2007-2019.

Diablo and Gorge lakes are generally operated within approximately five feet of normal maximum water surface elevation but are also occasionally drawn down further for Project maintenance (Figures 4.3-7 and 4.3-8). As a result, areas below normal maximum water surface elevation in Diablo and Gorge are rarely subject to erosive forces.

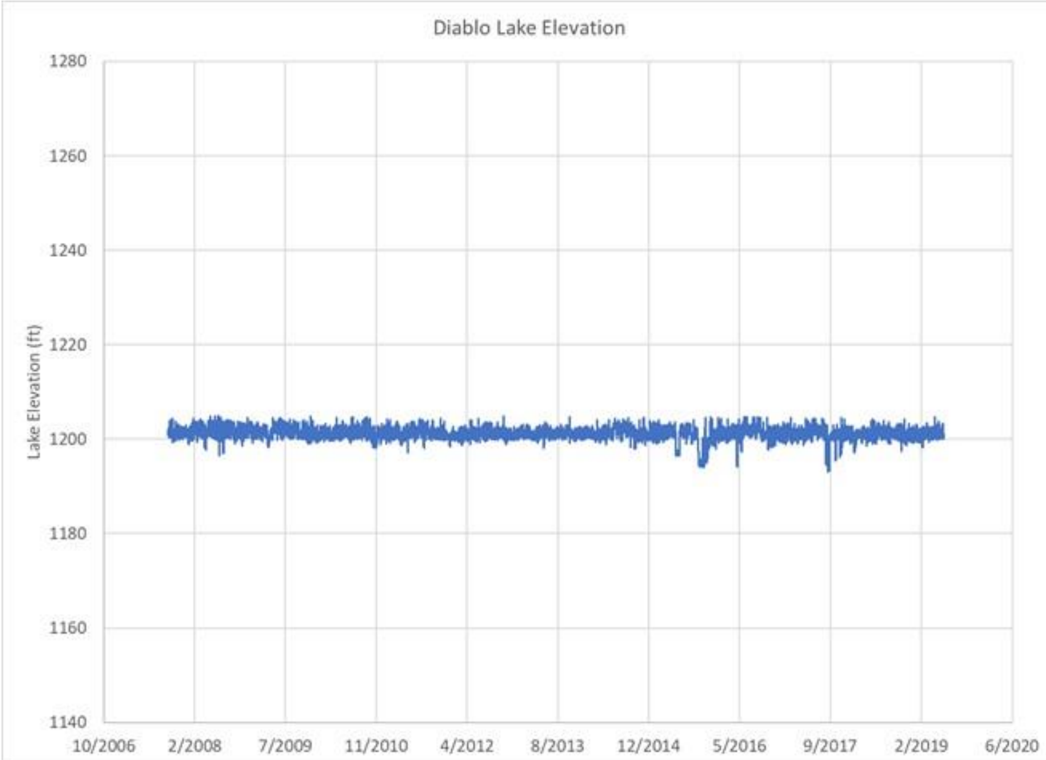


Figure 4.3-7. Diablo Lake elevation, 2007-2019.

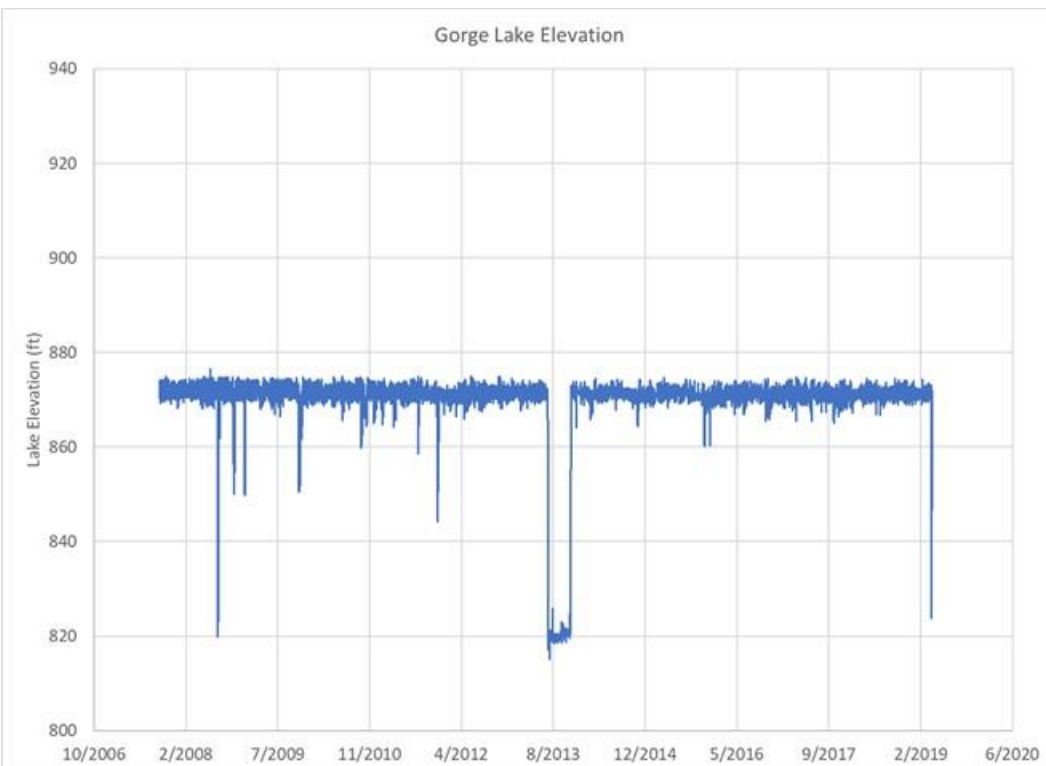


Figure 4.3-8. Gorge Lake elevation, 2007-2019.

As part of the 1990 shoreline condition inventory (Riedel 1990), information on bank material, bank slope, bluff height, sediment thickness, site aspect, and evidence for slope instability were recorded. Each eroding site was classified based on erosion type and extent based on the following criteria:

- Class I – over 1,000 cubic feet of mass movement had or could occur;
- Class II – less than 1,000 cubic feet of mass movement had or could occur with bluffs over 3-5 feet; and
- Class III - less than 1,000 cubic feet of mass movement had or could occur with bluffs less than 3-5 feet.

Shoreline condition at Ross, Diablo, and Gorge lakes varied considerably at the time of the 1990 report (Table 4.3-7). Approximately 26 percent of the Ross Lake shoreline was eroding to some extent, with 2 percent of the shoreline in Class I sites, 14 percent in Class II sites, and 10 percent in Class III sites. Most of the erosion sites were located in the lower and mid valley sections of the reservoir where colluvium and glacial sediments occur on steep valley slopes. Bluff sites at the Class I areas ranged from 5 to over 50 feet. Dominant processes affecting erosion were waves (wind waves and boat waves) undercutting the base of bluffs and some freeze-thaw activity or groundwater seepage contributing to instability. Erosion monitoring at five sites on Ross Lake has taken place over the period of the current Project license (NPS 2016). The greatest total amount of bank recession is at three sites with thick glacial deposits, where 14 to 18 feet of the bank have been eroded over 21 years. Relatively low rates of erosion were observed at the other two sites; one is a rocky slope with colluvial soils and the other is composed of very dense glacial till.

Table 4.3-7. Number of erosion sites and length (ft) and percentage of total shoreline eroding in 1990.

Erosion Class	Ross Lake	Diablo Lake	Gorge Lake
Class I	34 sites; 6,529 ft; 2%	5 sites; 1,801 ft; 2%	3 sites; 312 ft; <1%
Class II	719 sites; 40,072 ft; 14%	17 sites; 2,310 ft; 3%	3 sites; 341 ft; <1%
Class III	390 sites; 29,878 ft; 10%	56 sites; 3,927 ft; 5%	11 sites; 272ft; <1%
Total	**1,143 sites; 76,479 ft; 26%**	**78 sites; 8,038 ft; 10%**	**17 sites; 925 ft; 2%**

Source: Riedel 1990.

At Diablo Lake, 10 percent of the shoreline was eroding; much of the lake perimeter consists of relatively stable material. The eroding areas were glacial till and colluvium; wave action was the primary cause of eroding areas. The Gorge Lake shoreline is composed of very stable material; only 2 percent of the shoreline was eroding, again primarily mass wasting due to waves undercutting areas of unstable soil.

4.3.4.2 River Shorelines

There are three riverine shoreline sections associated with the Skagit River Project and its operations:

- A short section of river (which varies in length as reservoir levels fluctuate) between Diablo Dam and the head of Gorge Lake

- Between Gorge Dam and Gorge Powerhouse
- Downstream of Gorge Powerhouse

The short section of the Skagit River between Diablo Dam and the head of Gorge Lake is regulated by daily discharge from the Diablo Powerhouse and the level of Gorge Lake. The entire left bank and canyon section of the right bank is primarily bedrock; the lower portion of the right bank consists of fill from construction of the road and townsite.

Flow in the Skagit River between Gorge Dam and Gorge Powerhouse, also known as the bypass reach, is limited to tributary and groundwater inflow during most of the year and occasional spills from Gorge Dam (see Section 3.5.1 of this PAD for spill frequency and duration). This 2.5-mile reach is a narrow bedrock canyon; river shorelines are composed primarily of bedrock and large boulders.

Downstream of the Gorge Powerhouse, the Skagit River flows 94 miles to Puget Sound. Major tributaries include the Cascade River, Sauk River, and regulated Baker River, which are 16, 27, and 38 miles downstream from Gorge Powerhouse, respectively. A recent inventory of hydro-modified banks (riverbanks stabilized by rip rap) found that approximately 14.5 percent of the right bank of the Skagit River between Gorge Powerhouse and the Sauk River was hydro-modified, with 1.5 percent of the left bank protected by rip rap (Hartson and Shannahan 2015). In the Middle Skagit River, between the Sauk confluence and the Highway 9 Bridge, approximately 17 percent of the right bank and 10 percent of the left bank was hydro-modified.

4.3.5 Known or Potential Effects

4.3.5.1 Project-Related Effects

Operation of the Skagit River Project contributes to erosion around Project reservoirs (Riedel 1990). An inventory of erosion sites for the current Project license identified erosion along 26 percent of the Ross Lake shoreline, 10 percent of the Diablo Lake shoreline, and 2 percent of the Gorge Lake shoreline. Bank retreat along Project reservoirs was estimated to be an average loss of 1.7 acres per year of upland habitat around the lakes (Riedel 1990) as well as documented effects to recreation and cultural resources. During the current Project license, erosion control efforts have been undertaken at sites along Ross Lake where erosion was affecting recreation resources, treating approximately 0.3 miles of previously eroding shoreline.

Operation of the Skagit River Project also contributes to erosion at Project access roads and townsites (Riedel 1990). Sixteen minor erosion sites were identified along 14.8 miles of surveyed Project-related unpaved roads. There is a potential for additional erosion sites from Project-related roads along the transmission line corridor and associated with Project fish and wildlife mitigation lands, but little information exists to evaluate the extent of these effects. During the current license term, transmission towers have been moved or protected from landslide and channel migration hazards.

Flows below Gorge Powerhouse are managed to regulate flows for anadromous fish protection and provide flood control. The effects of peak flow reduction decrease downstream of the Project as tributary inflows enter the Skagit River. No recent comprehensive inventory of channel migration has been made in the Skagit River upstream of the Sauk River confluence, but analysis for the current Project license (Riedel 1990) showed only minor amounts of channel migration in the Skagit River upstream of the Sauk River. The analysis suggested that the reduced peak flows and vegetated riverbanks limited channel migration as well as cumulative effects from hydro-modified banks and changes to large woody debris (LWD) and sediment loading.

There are several sites with known or suspected legacy soil contamination in the Project Boundary:

- Former Household Waste Dump Sites – Because of the remote location and lack of road access, household waste was disposed of locally. How long this practice lasted is unknown, but anecdotal information suggests it likely persisted until the early 1970s. The dump for Diablo was near the current site of Gorge Campground. Groundwater samples from seven locations in this area were collected by USGS in 2013. The analysis showed no organic contaminants above drinking water standards. One sample had an arsenic level that exceeded the Environmental Protection Agency (EPA) drinking water standards; slightly elevated concentrations of cadmium and copper were also detected, in one sample each. The report concluded that overall, the metals concentrations in these samples were not exceptional and/or the known, high mineralogy of the area (USGS 2014).
- Two dump sites used in Newhalem – The original site was near the sandblast building on the west end of Newhalem. Use of this site was reportedly discontinued in the mid-1950s and moved to a site near Goodell Creek, which is thought to have been used through the early 1970s. Observational evidence suggests that some of the material from the later dump was incorporated as structural fill into the construction of the existing levee on the east side of the creek. In July 1987, after a file review and on-site inspection of the two Newhalem sites, EPA concurred with their consultant's finding that No Further Action under Superfund was recommended, and that no report or indication of any hazardous substances having been disposed of in either location had been found. A Site Hazard Assessment completed by Whatcom County Health Department in 2006 resulted in an Ecology determination of No Further Action for both dump sites in Newhalem. Water sampling was conducted by USGS in 2017 near the Goodell Creek site; however, City Light has not yet been provided with the results. Additional field assessment may be needed for any projects proposed at the dump sites that would result in soil disturbance.
- Diablo Marine Railway and Shelter (aka Diablo Dry Dock) – This facility is on the shoreline of Diablo Lake near the mouth of Deer Creek and was used to build, repair, and maintain City Light boats. It was constructed in 1935 and is a simple structure, open to the weather on two sides and lacking a floor. Soil and sediment samples were collected by City Light in and around this facility in 2014 and 2015. These investigations found elevated levels of arsenic, lead, and cPAH above Model Toxics Control Act Method A or B cleanup levels for unrestricted land use but no samples were classified as dangerous waste. This site is subject to an Administrative Settlement Agreement and Order on Consent with the NPS.

Several other contaminated soils sites associated with the Project have been investigated, cleaned up and/or addressed by implementing institutional controls. These include a cleanup of the area around Ladder Creek tank, which burned in the 2015 Goodell Creek fire, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and a site in Diablo that was used to dump used motor oil. There is also an area near the Diablo Boathouse where sandblast material from paint removal was reportedly dumped in several locations. This area was evaluated by City Light consultants in the 1980s and determined to be a visual nuisance but did not warrant further testing or cleanup. Other sites are either currently listed or de-listed via No Further Actions by Ecology. None of these sites require active cleanup.

4.3.5.2 Cumulative Effects

The direct effects of the Project (i.e., shoreline erosion due to Project operations and Project-related road erosion) combined with erosion from mining activities in the upper Skagit watershed and erosion associated with NPS facilities and roads within RLNRA may result in cumulative effects. Because there is little documentation of the magnitude of erosion from mining or on land managed by NPS, the magnitude of potential cumulative effects on geology and soil resources cannot be reliably estimated.

There may be cumulative effects on Skagit River bank erosion downstream from Gorge Powerhouse. Operation of the Skagit River Project reduces bank erosion by reducing peak flow events. Bank armoring unrelated to the Project also decreases bank erosion and limits channel migration. Past and current timber harvest in sub-watersheds downstream from Gorge Powerhouse, and particularly below Marblemount, have been documented to increase coarse sediment loads to streams entering the Skagit River (Paulson 1997). The combined effect of reduced peak flows and increased coarse sediment loads may cumulatively affect shoreline erosion in this section of the Skagit River.

4.3.6 Existing or Proposed Protection, Mitigation, and Enhancement Measures

4.3.6.1 Existing Measures

Article 409 of the current Project license specifies: "File a Project Soil Erosion Control Plan with FERC within 180 days of license issuance. Plan is to implement provisions included in the Settlement Agreement Concerning Erosion Control and the Erosion Control Plan filed on April 30, 1991 for 37 project-related recreation sites and 18 project related roads."

An Erosion Control Plan was developed and implemented by City Light and NPS as part of Article 409 compliance (Riedel et al. 1991). The plan prioritized sites based on potential for erosion effects to recreational, biological, or cultural resources. Erosion sites that were affecting recreation, Project facilities, and road erosion sites were recommended for future erosion control work. Other sites were recommended for monitoring to better evaluate erosion rates and bank recession (five sites on Ross Lake were chosen for long-term monitoring). The erosion control treatments, monitoring, and repairs have been undertaken on a progressive basis by NPS and funded by City Light. Annual reports on erosion control measures and erosion monitoring have been filed with FERC during the current Project license period (see NPS annual Erosion Control Program Completion Reports for details).

As of 2017, a total of 25 recreation sites covering nearly one third of a mile of stabilized shoreline, including docks, campgrounds, and trails were treated with stabilization measures (NPS 2018; Table 4.3-8). Sites are assessed annually and maintained as needed and are in fair to excellent condition (Table 4.3-8).

Table 4.3-8. Summary of recreation-related erosion control sites with condition assessment as of 2017.

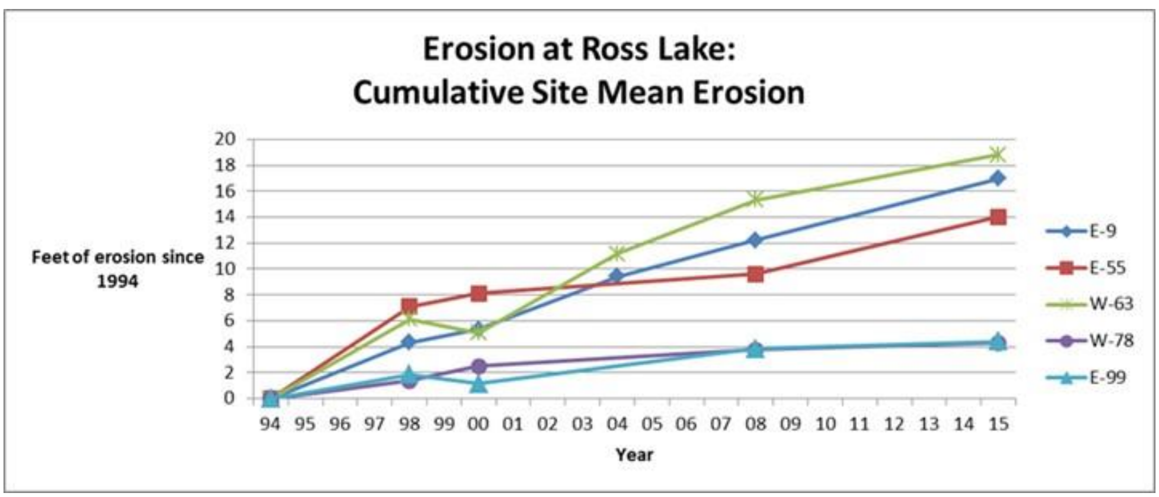
Priority	Site No.	Site Name, Dimensions, and Erosion Control Method	Year Construction Completed	Year Vegetation Planted - Number of Plants	Square Feet	Condition Assessment 2017 1 (low) – 10 (high)
Low	E-40	McMillian-rock wall 33 ft x 3ft	2004		30	2
Medium	E-47	May Creek -rock wall 39 ft x 4.5 ft (north of dock) 4 ft x 4.5 ft, (south of dock)	2002		150	5
High	E-56	Rainbow Point-rock wall 170 ft x 4 ft	NA		680	Not visited
High	E-64	East Bank Trail-reroute 120 ft x 3 ft (height estimated)	2003		~360	Not visited
High	E-68	East Bank Trail-rock wall 80 ft x 4 ft	2003		320	Not visited
High	E-70A-1	East Bank Trail-cribbing 30 ft by 60 ft	1995		213	6/7
High	E-70A- IA	East Bank Trail-cribbing	1997-98	1998-193	675	6/7
High	E-70A-2	East Bank trail-cribbing Upper tier: 35 ft x 6 ft Lower tier: 30 ft x 6 ft	1996-97	1998-675	390	6/7
High	E-70A-3	East Bank trail-cribbing 100 ft x 15 ft	1998	1999-357	1500	6/7
High	E-70A-4	East Bank trail-cribbing 45 ft x 25 ft	2001		1125	6/7
High	E-70A-5	East Bank trail-cribbing 30 ft x 3 ft and 50 ft x 10 ft Also 40 ft x 5 ft mid-section	1995	1998-207	500	6/7
High	E-70A- 5A	East Bank trail-cribbing	1997	2000-147	384	6/7
Medium	E-70A-6	East Bank trail-cribbing No rebuild, only reveg 2000 ft^2	2000-01	2001-240		6/7
High	E-80A	Devils Junction-rock wall 103 ft x 4.5 ft	1992	1999-101	500	7
Medium	E-80B	Devils Junction-rock wall 44 ft X 2-3 ft	2004	2000-97	132	Not visited

Priority	Site No.	Site Name, Dimensions, and Erosion Control Method	Year Construction Completed	Year Vegetation Planted - Number of Plants	Square Feet	Condition Assessment 2017 1 (low) – 10 (high)
Medium	E-100	10 Mile-rock wall and logs 54 ft x 3.5 ft (E of NE point) 60 ft x 4 ft (W of N point)	2001	2001-360	190	8
Medium	E-112	Dry Cr.-rock wall and logs 23 ft x 3 ft (SE comer of campground) 45 ft x 4.5 ft (S shore of campground)	1999	1999-166	~260	6/7
Low	E-87	Ponderosa -rock wall 141 ft x 5 ft	2003		750	8
Medium	E-92	Lodgepole-rock walls Two 10 ft x 3- 4 ft	2004		80	Not visited
Medium	E-95	Lightning Horse-rock wall 287 ft x 4-4 ft Faced with 2 to 3' diameter rocks	1998-99	1999-625 2001-239 2017-65	~1140	8
High	E-116	Lightning Trail- reroute By Geographic Information System (GIS) and maps about 350 ft long			~700	Not visited
Low	E-117	Lightning Trail- rock wall 60 ft X 2-3 ft	2000		~240	10
Medium	E-118A	Lightning Camp-log or wall Two 20 ft x l ft walls	2000		40	Not visited
Medium	E-118B	Light Camp-rock wall 45 ft x l ft	2000	2000-190	45	Not visited
High	E-134A	Cat Island- rock wall 18 ft x <2 ft	2000	2001-150	1000	7
Medium	E-134B	Cat Island-rock wall 50' x 6 ft (W of dock) 68 ft x 3.5 ft (Further W of bedrock)	2001		130	7
High	E-181	Boundary bay-rock wall 155 ft x 4-5 ft	1993	2000-633	~1000	5/6
High	W-34	Big Beaver trail- rock wall 200 ft x 3 ft	1996	2001-463 2016-548	600	8/9
Medium	W-36	Big Beaver- rock wall 50 ft x 2 ft	2002		100	8

Priority	Site No.	Site Name, Dimensions, and Erosion Control Method	Year Construction Completed	Year Vegetation Planted - Number of Plants	Square Feet	Condition Assessment 2017 1 (low) – 10 (high)
Medium	W-124	Little Beaver- rock wall, steps Stairs are 25 ft section	1998	2000-463		5
High	W-125	Little Beaver-rock wall 70 ft X 5-6 ft	NA	Trail and dock moved	~420	Not removed yet
High	W-126	Little Beaver Trail - cribbing and dock removal	NA	Trail and dock moved		Not removed yet
High	D-11	Thunder Pt-rock wall 290 ft x 2-3 ft	2005		870	Not visited
Medium	D-40	Power Line-rock and log boom 93 ft x 2-3 ft	2005		279	Not visited
High	D-43	Buster Brown-rock wall 100 ft x 3.5 ft	2005		350	Not visited

Source: NPS 2018.

As part of the Erosion Control Plan, NPS has monitored five bank erosion sites, all of which are at Ross Lake. The most recent monitoring occurred in 2015. Each of the five sites monitored has a different rate of erosion because of varying bank material, aspect, and slope (NPS 2016; Figure 4.3-9). The greatest total amount of bank recession is at three sites with thick glacial deposits (E9, E55, and W63), where erosion has claimed 14 to 18 feet of the bank in 21 years. Relatively low rates of erosion were observed at the other two sites with four feet of erosion in 21 years. Site E99 is a rocky slope with colluvial soils, while site W78 has a shoreline composed of very dense glacial till.



Source: NPS 2016.

Figure 4.3-9. Total bank recession at Ross Lake monitoring sites (1994-2015).

4.3.6.2 Proposed Measures

City Light proposes to develop an updated Erosion Control Plan for the reservoir shorelines and Project roads. City Light will develop a comprehensive Transmission Line Corridor Management Plan that includes best management practices (BMP) to protect natural and cultural resources from direct and indirect impacts from Project O&M activities as well as indirect impacts due to recreational use of City Light roads and trails.

4.4 Water Resources

This section of the PAD describes water resources associated with the Project, i.e., within the Project Boundary and within the Skagit River downstream to its confluence with the Sauk River. Conditions in select tributaries to Ross Lake are also discussed. Topics addressed include: (1) drainage basin hydrology; (2) groundwater conditions; (3) Project streamflow and reservoir elevation data; (4) existing and proposed uses of Project waters; and (5) water quality. Also addressed in this section is City Light’s assessment of Project-related and cumulative impacts to water resources, as identified based on existing information, and City Light’s rationale regarding potential water resources related PME measures.

4.4.1 Drainage Basin Hydrology

4.4.1.1 Watershed Description

The Skagit River originates in the Cascade Range and flows approximately 135 miles to Skagit Bay (USACE 2013). The northern end of the basin extends about 28 miles into Canada (USACE 2013). The Skagit River drainage basin (Figure 4.4-1) has a total area of approximately 3,115 sq. mi. (USACE 2013), with about 381 sq. mi. of this total located in British Columbia (USGS 2019a).

Annual precipitation ranges from 50 inches in the area of Ross Lake to as much as 130 inches in the mountains (Ecology 2016). The Skagit River basin experiences rain and snowmelt runoff during fall and winter and snowmelt runoff during spring. Spring runoff is typically characterized by a relatively slow rise and an extended duration, with maximum snowmelt discharges usually occurring in June (USACE 2013). The maximum spring snowmelt discharge, i.e., 92,300 cfs, was recorded at Mount Vernon in April 1959. The rate and peak of the snowmelt can be affected by warm spring rains, but the influence of rain-on-snow events is typically not significant (USACE 2013). The largest floods recorded in the basin have occurred in fall and winter.

Low flows in the Skagit River and its major tributaries usually occur in August and September after the high-elevation snowpack has melted and baseflows have receded (USACE 2013). Heavy precipitation in fall and winter produces significant flow increases in the Skagit River basin. Heavy rain during typical one- to three-day winter storms can cause streamflows to rise to flood levels in a few hours, after which flows tend to recede rapidly, although baseflows and soil moisture levels typically remain high for several days (USACE 2013). On mountain slopes, storm-related precipitation often persists as a result of the combination of frontal and orographic effects.

Historically, annual streamflows in the Pacific Northwest, aggregated over the Columbia River Basin, were higher in the latter half of the 19th century when compared to the 20th century. The highest annual flow year in the region was 1894, and 1974 and 1997 were the highest in the 20th century (Lee and Hamlet 2011). ENSO and PDO exert strong influences on summer streamflow: i.e., reductions during warm ENSO and PDO phases and increases during cool/neutral ENSO and cool PDO phases. The Skagit River basin has a temperature-sensitive snowpack, such that streamflow is influenced by precipitation falling as rain in fall and winter (Elsner et al. 2010). Retrospective hydrologic modeling studies show that the North Cascades area typically experiences the highest floods during cool PDO periods and ENSO-neutral years (Hamlet and Lettenmaier 2007). Variability in snowpack is noticeably influenced by ENSO and PDO cycles in the relatively warm mountains of the western slopes of the North Cascades in the Project vicinity (Lee and Hamlet 2011). For example, April 1 snow-water-equivalent (SWE) is 42 percent to 58 percent lower during warm phases of ENSO and PDO, respectively. An even more pronounced effect on snowpack occurs when the warm and cool phases of ENSO and PDO align, such that April 1 SWE is 85 percent lower during a coincident warm phase than a coincident cool phase. These impacts on snowpack can have large impacts on the amount and timing of streamflow.

Atmospheric rivers (also called “pineapple express” storms because of their origins) often bring large amounts of precipitation during the winter months and are frequently responsible for flooding (Dettinger 2011). According to Lavers et al. (2013), atmospheric rivers are expected to double in frequency and increase in intensity by the end of the 21st century due principally to increased atmospheric water vapor. The number of days with high water vapor content are also expected to increase, leading to heavier precipitation, and occur one to two months earlier (Warner et al. 2015). This is consistent with projected increases in future flood risk in early fall over the Pacific Northwest based on regional climate models (Salathé et al. 2014).

Considering low flows, since the mid-20th century, the lowest 25 percent of annual streamflows in the Pacific Northwest have been in decline; essentially, the driest years are becoming substantially drier (Luce and Holden 2009). Changes in streamflows are largely associated with declines in spring SWE linked to warmer temperatures (Mote et al. 2005). In the western United States, the timing of spring runoff in snowmelt-dominated rivers has shifted one to three weeks earlier over the latter half of the 20th century, attributed to warming temperatures (Stewart et al. 2005) and potentially decreased mountain precipitation (Luce et al. 2013). Warming from anthropogenic climate change has contributed to approximately 60 percent of the observed changes in western hydrology (Barnett et al. 2008).

Projected changes in streamflow are anticipated due to higher levels of cool-season precipitation coupled with a shift from snow to rain in many mid elevation regions. Low flows are expected due to drier summer conditions, reduced snowpack, earlier snowmelt, and elevated evapotranspiration (Salathé et al. 2014; Tohver et al. 2014; Lee and Hamlet 2011; Hamlet et al. 2013; Neiman et al. 2011).

The snow drought of 2015 has been considered a possible precursor of potential future climate in Washington (Marlier et al. 2017). That year over 80 percent of snow courses in the Western United States reported record low April 1 SWE due to exceptionally warm (+3.8 °F) winter temperatures (Mote et al. 2016). However, a study by Marlier et al. (2017) found that the North Cascades did not have extreme low April 1 SWE or winter (November – March) precipitation (ranking thirteenth and fortieth over 1950–2015, respectively) despite the second warmest winter (+3.4°F) on record. Comparing 2015 weather to projections for 2040–2069 in the North Cascades, the average from 10 global climate models indicates higher winter temperatures, higher winter precipitation, and lower SWE than 2015. This suggests a transition from precipitation to temperature control of future droughts, although the likelihood of consecutive years of drought would exacerbate 2015 conditions.

Warming is projected to result in about an 80 percent reduction in spring snowpack in the Cascades by the 2080s compared to 1970–1999 (Gergel et al. 2017). Peak snowfall is projected to be earlier by 30-40 days (Stewart et al. 2004) and up to two months by the end of the 21st century (Rauscher et al. 2008).

Runoff from unregulated watersheds[8] in the Skagit River basin has a substantial effect on flooding in the lower Skagit Valley (i.e., within the levee system from Burlington to the distributary mouths). Flood runoff from unregulated drainages during events greater than the four percent exceedance frequency at Mount Vernon (i.e., a 25-year flood event) is sufficient to produce major flooding in the valley regardless of the flood control measures undertaken at Ross and Upper Baker lakes (USACE 2013). The floods of November 1990 and November 1995 were five to six percent exceedance frequency events (i.e., 16-20 year events) that raised the river to the tops of the main levees (USACE 2013).

[8] The Sauk and Cascade rivers are the large unregulated sub-drainages within the Skagit River basin.

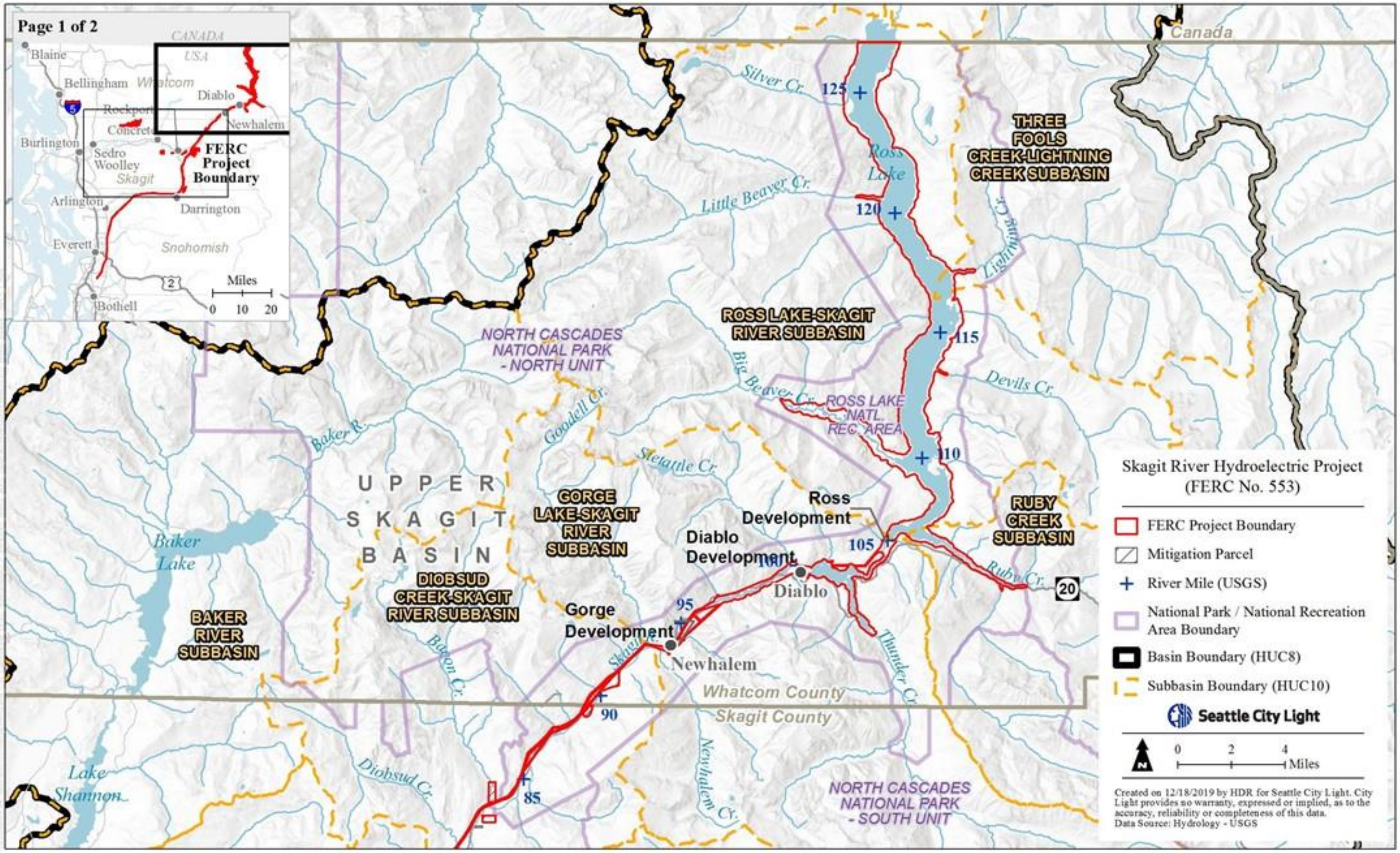


Figure 4.4-1. Boundaries of the Skagit River drainage basin and its major subbasins (page 1 of 2).

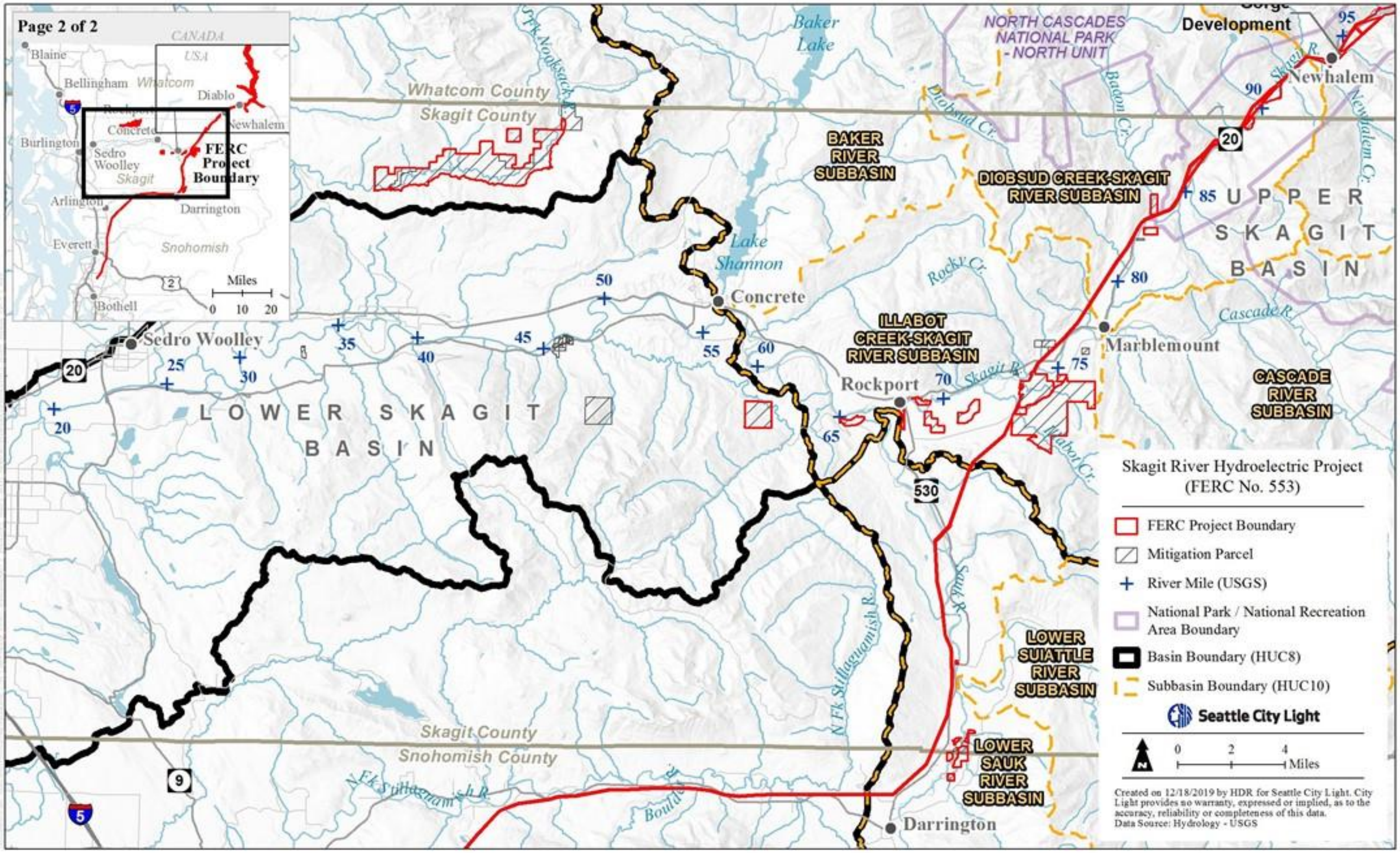


Figure 4.4-1. Boundaries of the Skagit River drainage basin and its major subbasins (page 2 of 2).

4.4.1.2 Reservoirs

The Project consists of three power generating developments on the Skagit River, Ross, Diablo, and Gorge, located between RM 94 and RM 127. Operations at the three Project developments are hydraulically coordinated.

Ross Lake

Ross Lake, the uppermost Project reservoir, has a drainage area of approximately 1,000 sq. mi. The reservoir is 24 miles long, with an average width of 4,271 feet, and extends about 1 mile north of the U.S.-Canada border. It has a surface area of 11,680 acres, with about 500 acres located in British Columbia, and a gross storage volume of 1,435,000 acre-feet at the normal maximum water surface elevation of 1,602.5 feet. The reservoir's useable storage is 1,052,000 acre-feet. At normal maximum water surface elevation, Ross Lake has a mean depth of 122.5 feet (Johnston 1989) and a maximum depth near the dam of 400 feet (Looff 1995). The shoreline length is 84.2 miles (as calculated from LIDAR; 69.9 miles in the U.S. and 14.3 miles in Canada) at normal maximum water surface elevation. The shoreline of Ross Lake consists of bedrock, talus, colluvium, glacial till, outwash deposits, alluvial fan, alluvium, landslide, and fill (the relative proportions of these materials are provided in Section 4.3 of this PAD). Reservoir detention time is 189.4 days (Connor 2019).

The majority of flow into Ross Lake originates in the upper Skagit River, although several other tributaries, including Ruby, Lightning, and Big Beaver creeks (which drain 209, 133, and 64 sq. mi., respectively (USGS 2019a)) also make significant contributions. Multiple other smaller streams provide input as well.

Diablo Lake

Diablo Lake, the middle of the three Skagit River Project reservoirs, is about 4.5 miles long, with an average width of 1,323 feet. It has a drainage area of about 1,125 sq. mi. (inclusive of the Ross Lake drainage area) and a surface area of about 770 acres. At normal maximum water surface elevation, Diablo Lake has a maximum depth of 350 feet and a mean depth of 116 feet. Its gross storage volume is 50,000 acre-feet at the normal maximum water surface elevation of 1,205 feet; the reservoir's useable storage is 8,820 acre-feet. Reservoir detention time is 9.4 days (Conner 2019). The 20-mile-long reservoir's shoreline consists of bedrock, talus, colluvium, undifferentiated material, glacial till, alluvial fan, alluvium, and fill (the relative proportions of these materials are provided in Section 4.3 of this PAD).

Tributaries to Diablo Lake include Thunder, Colonial, Rhode, Sourdough and Deer creeks. All but Thunder Creek are small streams with short, steep drainage basins. Colonial Creek has a large alluvial fan that is an important habitat feature. Thunder Creek runs 15 RMs from the glaciers on Mount Torment to Diablo Lake, about 1 mile upriver of Diablo Dam. The heavily glaciated and forested watershed ranges in elevation from 1,220 to 8,815 feet, and the creek has a drainage area of 108 sq. mi. (USACE 2013). The entirety of Thunder Creek is located within RLNRA and North Cascades National Park. Thunder Creek provides about 18 percent of the inflow to Diablo Lake, on average, during summer and up to 54 percent during drought years (1910-2018).

Gorge Lake

Gorge Lake, the most downstream of the Project reservoirs, is usually kept at or near normal maximum water surface elevation to provide maximum head for Gorge Powerhouse. The reservoir is about 4.5 miles long, with an average width of 450 feet. Gorge Lake has a surface area of about 240 acres and a gross storage volume of 8,500 acre-feet at a normal maximum water surface elevation of 875 feet; the reservoir's useable storage is 6,600 acre-feet. At normal maximum water surface elevation, Gorge Lake has a maximum depth of 140 feet and an average depth of 35 feet. There are six tributaries in the Gorge Lake watershed, with about 54 miles of stream drainage. The major tributaries are Stetattle and Pyramid creeks; the other four are relatively short, steep drainages. Reservoir detention time is 0.8 days (Conner 2019). The reservoir's shoreline consists of bedrock, talus, colluvium, undifferentiated material, alluvial fan, alluvium, and fill (the relative proportions of these materials are provided in Section 4.3 of this PAD).

4.4.1.3 Skagit River and its Major Tributaries

The reach of the Skagit River between Gorge Dam and Gorge Powerhouse, referred to as the bypass reach, is about 2.5 miles long. Under the 1995 Skagit River Project License, City Light is not required to release any flow into the Gorge bypass reach (FERC 1995). Flows in the bypass reach are limited to accretion flow, spill-gate seepage, intermittent tributary input, and precipitation runoff, except when water is being spilled at Gorge Dam.

The Skagit River channel in the area immediately downstream of the Project is constricted, with little floodplain due to the steep surrounding terrain. With increasing distance downstream of the Gorge Powerhouse the floodplain broadens and the channel is less confined. A stream gradient profile is provided in Figure 4.4-2. Major tributaries include the Cascade, Sauk, and Baker rivers, which enter the Skagit River near the towns of Marblemount, Rockport, and Concrete, respectively.

The Cascade River, which runs for 29 RMs to its confluence with the Skagit River at RM 78.1, has a drainage area of 185 sq. mi. Elevations in the basin range from 185 to 8,300 feet. The river exits a canyon at about RM 3.3, where the floodplain is approximately 400 feet wide, and enters a broader valley bottom; the floodplain widens to about 2,800 feet at the confluence of the Cascade and Skagit rivers. The 21.8 miles of Cascade River outside North Cascades National Park and the Glacier Peak Wilderness Area are designated as part of the Skagit River Wild and Scenic River System (USACE 2013).

The Sauk River is the largest Skagit River tributary and enters the Skagit River from the south at about RM 67.2. The Sauk River is more than 50 miles long and has a drainage area of 732 sq. mi., which accounts for more than 25 percent of the total drainage area of the Skagit River at the town of Concrete. Elevations in the basin range from 210 feet to 10,541 feet. Input from the Sauk River represents just over 50 percent of the uncontrolled drainage area in the Skagit River basin, and as a result it is the largest contributor to flooding in the Skagit River (e.g., 52 percent of the 100-year flood event). Two large tributaries flow into the Sauk River from Glacier Peak: the 40-mile-long Suiattle River (346 sq. mi. drainage area), which enters the Sauk River at RM 13.2, and the White Chuck River (86.2 sq. mi. drainage area), which enters the Sauk River at RM 31.9. The Sauk and Suiattle rivers are part of the Skagit River Wild and Scenic River System (USACE 2013).

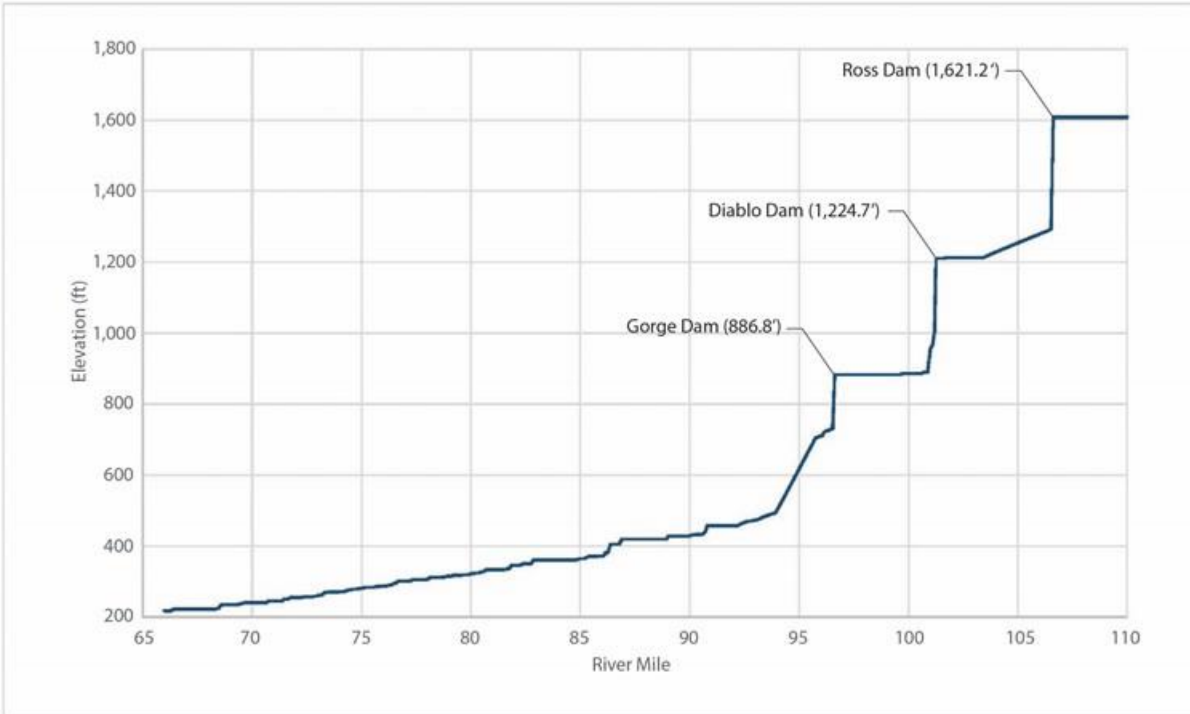


Figure 4.4-2. Gradient profile of the Skagit River from Gorge Dam to the confluence of the Skagit and Sauk rivers and the heights of the three Project dams (elevations in NAVD 88).

The Baker River is the second largest tributary to the Skagit River, with a watershed of about 298 sq. mi. (USACE 2013). The Baker River drains the north central portion of the Skagit River basin and enters the Skagit from the north at RM 56.5 (USACE 2013). Elevations in the basin range from 170 to 10,775 feet, with approximately two-thirds of the basin located below an elevation of 4,000 feet (USACE 2013). The Baker River valley is geologically distinct from most of the other Skagit River tributaries, due largely to the influence of Mount Baker. The Baker River is regulated by two dams owned by PSE.

4.4.2 Project Streamflow Data

4.4.2.1 Current and Historic USGS Gaging Stations

There are two USGS stream gages on the Skagit River upstream of the Sauk River confluence: the Skagit River at Newhalem (USGS #12178000) and the Skagit River at Marblemount (USGS #12181000). The available periods of record for the gages are December 1908 – May 2019 and September 1943 – May 2019, respectively. There is also a gage on the Skagit River in British Columbia (i.e., #08PA012 Skagit River Above Klesilkwa River), funded by City Light and operated by Environment Canada and Climate Change, Ministry of Forests, Lands, Natural Resource Operations & Rural Development. The gage became operational in 2019.

USGS stream gages on tributaries to the Project reservoirs include Ruby Creek below Panther Creek near Newhalem (USGS #12173500; elevation 1,640 feet), Big Beaver Creek near Newhalem (USGS #12172000; elevation 1,600 feet), and Thunder Creek near Newhalem (USGS

#12175500; elevation 1,220 feet). These gages have the following periods of record, respectively: April 30, 2018 – present, June 27, 2018 [9] – present, and October 1, 1930 – present.

4.4.2.2 Project Outflows

The minimum and maximum daily and the monthly average outflows from Ross, Diablo, and Gorge lakes for the period 1991–2018 are provided in Tables 4.4-1 through 4.4-3. The period 1991-2018 encapsulates the timeframe beginning with the finalization of the Settlement Agreement (i.e., in 1991) (see Section 3.3 of this PAD) and ending with the most recent full water year. This period is sufficiently long to account for operations under a range of hydrologic conditions. Outflow from the Ross and Diablo developments is calculated from generation and spill data. Outflow from the Gorge Development is measured at the USGS stream gage in Newhalem, just downstream of the powerhouse.

Ross Lake outflows ranged from a low of 0 cfs, which occurred during 16 months in the period of record, to a high of 14,819 cfs in November 1995 (Table 4.4-1). Outflows from Diablo Lake ranged from a low of 12 cfs in August 2015 to a high of 12,456 cfs in December 2017 (Table 4.4-2).[10] Gorge Lake outflows ranged from a low of 1,570 cfs in June 1993 to a high of 32,700 cfs in October 2003 (Table 4.4-3).[11]

[9] The stated period of record for Big Beaver Creek is associated with a newly installed stream gage. There are also daily discharge data for Big Beaver Creek from the 1940s, 1950s, and 1960s, although measurements are not continuous for these historical periods.
[10] There are two data gaps, i.e., 6/7/1996–6/13/1996 and 8/20/2015–8/28/2015, during which no data are available for Ross and Diablo lakes. The monthly statistics are based on the days for which there are data in those months.
[11] There is a data gap from December 2014 through February 2015 in the daily data from the USGS gage at Newhalem; City Light used the 15-minute data table from the USGS to calculate the daily data for the missing period (USGS 2019b).

Table 4.4-1. Monthly minimum, average, and maximum outflows (cfs) from Ross Lake (1991-2018).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	Maximum	7,053	13,590	7,204	6,929	6,800	5,138	14,412	5,672	5,762	3,551	4,343	4,049	14,412
	Average	5,243	8,695	6,043	4,614	4,356	2,961	7,250	3,806	2,605	2,434	2,359	2,877	4,416
	Minimum	3,705	3,736	2,954	2,341	2,894	445	2,931	1,088	991	1,243	301	1,244	301
1992	Maximum	6,349	6,829	6,540	4,332	1,732	1,632	4,256	3,574	2,352	5,173	5,308	4,339	6,829
	Average	4,906	5,909	4,740	2,503	897	770	3,097	2,361	1,216	2,171	3,661	3,018	2,931
	Minimum	3,270	3,451	3,099	0	0	0	468	782	0	935	1,427	1,279	0
1993	Maximum	5,163	4,700	2,546	2,805	1,147	1,307	3,972	2,924	2,673	2,603	5,576	3,886	5,576
	Average	3,346	3,389	1,655	1,703	211	258	2,031	1,733	1,995	2,055	3,658	2,779	2,059
	Minimum	1,500	1,905	0	1,207	0	0	294	761	825	874	1,014	1,302	0
1994	Maximum	5,904	5,874	3,969	4,256	2,770	2,544	3,254	3,532	3,025	3,086	4,508	4,254	5,904
	Average	3,785	3,716	2,732	3,114	1,542	1,169	1,848	2,231	2,400	1,864	2,543	2,756	2,467
	Minimum	1,925	649	1,085	1,774	485	0	851	1,132	1,605	823	680	707	0
1995	Maximum	7,262	5,856	6,411	5,964	4,261	3,775	3,027	3,483	2,602	3,139	14,819	13,630	14,819
	Average	5,046	4,517	5,383	3,745	2,416	1,512	1,212	2,206	1,875	1,875	7,525	6,856	3,674
	Minimum	3,144	2,092	4,170	1,404	742	0	6	1,259	1,068	450	25	1,570	0
1996	Maximum	7,461	7,792	6,099	5,910	5,266	4,381	4,801	3,497	4,254	4,742	4,751	4,787	7,792
	Average	4,747	4,216	5,008	4,267	3,941	2,230	2,941	1,865	2,200	2,301	3,122	3,409	3,353
	Minimum	877	1,327	3,409	2,242	2,578	0	19	772	1,172	717	1,632	1,872	0
1997	Maximum	6,961	6,765	7,124	7,095	6,865	10,368	10,124	4,367	3,419	10,188	9,678	4,770	10,368
	Average	4,381	5,367	5,672	5,445	4,559	6,365	6,328	2,548	1,809	3,488	4,767	3,511	4,512
	Minimum	968	3,808	621	3,139	1,878	1,990	3,127	1,386	392	1,049	2,164	2,572	392
1998	Maximum	7,421	4,738	5,523	5,240	1,989	1,742	3,886	4,200	3,486	3,485	3,250	5,755	7,421
	Average	4,554	3,880	4,217	3,821	970	719	2,048	2,013	2,388	2,562	2,436	2,776	2,693
	Minimum	2,789	3,182	3,190	1,517	68	142	456	531	1,419	0	1,016	143	0
1999	Maximum	6,305	6,878	7,143	5,167	5,090	5,576	10,555	9,814	4,051	3,675	13,643	4,911	13,643
	Average	5,210	6,129	5,186	2,832	3,517	2,949	5,789	4,995	2,937	2,856	5,493	3,311	4,260
	Minimum	2,153	4,872	3,108	631	593	408	3,090	1,618	2,145	594	133	1,155	133
2000	Maximum	6,921	5,781	5,050	3,971	3,795	3,442	4,829	3,811	3,886	3,318	6,310	5,071	6,921
	Average	5,783	5,065	4,145	2,639	1,787	1,321	3,586	2,445	2,521	2,563	3,452	3,011	3,191
	Minimum	4,296	4,247	3,121	1,810	190	3	2,231	900	970	975	2,334	1,615	3

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	Maximum	4,073	3,170	2,667	2,138	1,405	1,616	2,495	3,798	3,096	2,761	2,847	4,054	4,073
	Average	2,330	2,096	2,004	1,473	596	402	1,242	2,444	2,018	1,964	1,639	2,540	1,730
	Minimum	297	1,267	1,574	67	0	0	0	1,215	836	1,434	69	935	0
2002	Maximum	7,095	6,956	7,094	5,645	6,479	6,158	11,048	3,093	3,204	3,496	3,032	3,079	11,048
	Average	5,367	5,269	5,785	3,531	4,227	3,374	5,852	2,204	1,807	1,867	2,097	1,710	3,587
	Minimum	52	128	4,264	5	1,437	598	1,707	634	890	1,087	419	490	5
2003	Maximum	5,568	5,873	4,907	4,185	4,061	5,541	4,427	3,181	3,488	11,915	6,708	6,039	11,915
	Average	3,733	3,574	2,501	2,995	2,391	2,618	2,359	2,052	2,252	3,715	4,714	3,299	3,011
	Minimum	393	707	20	1,903	155	351	740	1,303	1,372	48	1,367	1,809	20
2004	Maximum	6,623	6,913	3,985	2,815	1,507	7,706	3,950	3,818	3,549	5,866	6,379	5,847	7,706
	Average	5,135	5,994	2,065	1,724	566	2,410	2,234	1,893	2,100	2,894	4,272	3,263	2,865
	Minimum	1,885	3,127	1,203	826	7	60	969	536	103	786	33	20	7
2005	Maximum	6,596	6,788	3,806	2,413	2,744	1,739	1,994	1,823	2,956	4,085	6,238	4,443	6,788
	Average	4,495	4,555	2,256	1,451	1,137	1,023	903	966	2,181	2,190	4,568	3,030	2,380
	Minimum	6	2,611	1,344	29	12	121	75	424	45	448	2,972	5	5
2006	Maximum	6,512	6,616	7,209	2,446	1,918	1,905	4,177	1,799	2,660	2,192	10,032	4,070	10,032
	Average	4,444	5,737	5,386	1,613	866	856	2,073	1,221	2,030	1,438	5,591	3,173	2,849
	Minimum	1,530	3,821	1,718	307	15	25	271	772	1,144	463	50	1,648	15
2007	Maximum	6,925	7,126	6,040	5,809	4,038	7,622	8,402	3,073	2,938	6,069	4,210	4,187	8,402
	Average	5,371	5,796	4,539	4,339	2,016	4,765	4,733	1,582	2,131	2,980	2,891	2,979	3,661
	Minimum	2,356	4,754	75	2,600	614	449	1,854	570	497	1,356	1,280	9	9
2008	Maximum	6,767	6,863	5,746	4,115	2,101	2,571	9,863	3,225	4,007	3,325	4,032	4,272	9,863
	Average	5,109	4,693	3,899	2,670	562	1,128	4,032	1,990	2,683	2,696	2,252	3,224	2,910
	Minimum	3,554	2,247	2,113	843	19	129	1,303	581	1,841	1,399	56	2,127	19
2009	Maximum	4,083	4,456	3,002	4,226	1,552	6,853	4,125	3,272	3,172	2,855	8,177	5,386	8,177
	Average	2,912	3,514	2,365	2,218	764	3,009	2,477	1,660	1,672	1,949	5,432	4,071	2,659
	Minimum	1,383	2,207	1,568	917	82	8	1,022	455	477	50	906	2,887	8
2010	Maximum	4,710	5,164	3,344	3,589	2,927	5,224	5,720	3,511	3,685	7,134	3,992	4,478	7,134
	Average	3,511	3,437	2,689	2,535	1,864	2,053	4,181	1,866	1,986	4,187	2,585	2,585	2,790
	Minimum	2,821	2,217	1,670	1,547	235	299	2,416	1,139	347	157	1,092	744	157

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2011	Maximum	6,301	6,616	6,806	4,787	5,017	5,285	8,001	5,469	3,868	3,125	5,988	3,868	8,001
	Average	4,058	5,659	5,220	3,743	2,687	3,096	5,577	3,538	2,525	2,544	3,451	3,290	3,773
	Minimum	40	4,281	2,459	2,504	1,377	647	3,458	1,673	161	1,453	745	2,074	40
2012	Maximum	5,207	6,219	6,576	3,969	4,667	9,917	9,355	4,827	3,403	2,951	8,999	4,703	9,917
	Average	4,161	5,644	4,426	2,386	3,344	5,633	6,328	2,733	2,186	1,898	5,179	3,893	3,977
	Minimum	2,289	4,984	2,703	32	1,911	716	2,551	985	1,597	0	2,529	3,216	0
2013	Maximum	6,938	6,017	4,293	4,081	3,504	4,336	3,983	3,252	3,520	6,777	4,061	4,095	6,938
	Average	5,380	4,689	3,122	2,970	1,875	2,866	2,524	1,928	2,344	4,495	3,330	3,711	3,262
	Minimum	3,921	4,053	2,292	1,560	37	1,414	793	827	970	2,040	2,802	2,639	37
2014	Maximum	4,054	5,193	4,460	4,851	4,237	8,701	8,587	3,583	3,620	4,181	9,331	11,434	11,434
	Average	3,219	3,745	3,312	3,842	2,498	4,663	5,121	1,866	2,419	2,354	4,179	5,144	3,526
	Minimum	2,051	2,593	743	3,016	715	1,861	1,766	516	1,225	935	43	2,696	43
2015	Maximum	6,772	6,997	6,619	3,565	2,464	3,846	2,814	1,305	4,030	4,312	5,919	5,240	6,997
	Average	4,935	5,340	4,092	2,740	1,290	1,798	1,664	583	2,773	3,106	3,145	4,227	2,959
	Minimum	685	559	1,343	1,823	61	440	554	0	410	1,089	908	1,057	0
2016	Maximum	7,329	6,374	6,558	4,326	5,491	5,254	4,207	2,512	4,131	5,694	9,886	6,598	9,886
	Average	5,429	4,821	5,053	2,779	3,069	2,812	2,443	1,731	2,957	3,390	3,618	4,100	3,515
	Minimum	939	439	3,729	138	1,009	329	783	703	1,398	275	938	2,596	138
2017	Maximum	7,315	3,681	6,783	4,917	5,552	9,040	4,414	3,086	4,500	4,255	9,719	11,706	11,706
	Average	4,940	2,473	3,545	4,010	3,525	4,686	3,019	1,869	2,864	2,826	3,701	4,712	3,519
	Minimum	2,150	450	1,105	2,660	562	2,368	1,808	744	1,009	608	702	2,708	450
2018	Maximum	5,945	11,591	13,269	2,572	3,011	3,507	3,490	3,396	4,085	4,666	4,097	3,978	13,269
	Average	4,904	7,391	6,496	1,918	1,226	2,139	1,993	1,911	3,347	3,550	2,936	3,346	3,407
	Minimum	3,584	3,859	2,303	987	166	742	518	905	844	1,722	430	2,347	166

Table 4.4-2. Monthly minimum, average, and maximum outflows (cfs) from Diablo Lake (1991-2018).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	Maximum	6,948	7,007	6,945	6,713	7,675	5,538	7,010	6,689	4,692	3,400	5,034	4,047	7,675
	Average	5,558	6,667	6,331	5,148	5,187	4,016	6,461	5,073	2,980	2,765	2,913	3,263	4,691
	Minimum	3,429	5,337	3,571	2,632	4,469	2,339	4,685	2,691	1,919	1,939	1,516	2,037	1,516

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1992	Maximum	6,051	7,030	6,797	4,599	2,774	2,613	5,158	4,351	3,091	4,942	4,954	4,069	7,030
	Average	5,416	6,352	5,153	3,104	1,820	2,160	4,145	3,427	2,072	2,582	4,035	3,357	3,629
	Minimum	3,706	5,329	3,517	1,429	1,491	1,637	1,895	2,057	1,439	1,342	2,691	1,716	1,342
1993	Maximum	5,517	4,857	2,493	2,533	3,475	2,161	4,709	3,539	3,531	2,839	5,780	4,088	5,780
	Average	3,557	3,613	2,086	2,022	1,761	1,405	2,878	2,638	2,450	2,480	3,862	3,105	2,651
	Minimum	2,043	2,137	1,757	1,760	857	969	2,003	1,658	1,603	2,141	2,424	2,046	857
1994	Maximum	5,632	5,696	4,561	4,295	3,147	2,611	3,589	3,618	3,550	3,012	4,194	4,151	5,696
	Average	4,088	3,980	3,233	3,666	2,498	2,091	2,994	3,041	3,098	2,217	2,806	3,220	3,072
	Minimum	2,506	1,794	1,959	2,771	2,061	1,706	1,941	2,167	2,718	1,522	1,736	2,193	1,522
1995	Maximum	6,590	6,353	6,620	6,126	4,566	4,499	3,759	3,834	3,145	3,234	7,208	6,884	7,208
	Average	5,295	5,362	5,788	3,995	3,574	2,848	2,741	3,085	2,544	2,528	5,268	5,590	4,045
	Minimum	3,681	4,186	4,677	3,065	2,102	1,838	2,083	1,542	1,722	1,629	2,659	2,484	1,542
1996	Maximum	7,122	6,920	6,877	6,550	5,337	4,922	6,523	4,494	3,517	3,459	5,027	4,298	7,122
	Average	5,164	4,933	5,410	4,914	4,678	4,193	4,507	2,938	2,939	2,900	3,651	3,627	4,152
	Minimum	2,415	2,297	4,197	3,640	3,543	3,202	2,516	2,115	2,117	2,060	2,318	2,577	2,060
1997	Maximum	6,874	6,542	6,916	6,698	6,635	7,507	7,044	6,281	3,101	6,913	6,811	4,032	7,507
	Average	4,845	5,666	6,067	5,924	6,036	6,446	6,239	3,462	2,558	3,733	4,990	3,727	4,969
	Minimum	1,723	4,230	3,403	3,651	5,191	5,641	4,169	1,889	1,970	2,304	2,815	2,941	1,723
1998	Maximum	6,433	4,883	5,434	5,102	2,358	2,678	5,863	4,349	4,008	3,499	3,434	5,039	6,433
	Average	4,835	4,001	4,330	4,031	1,999	2,001	3,406	2,981	2,989	2,891	2,828	3,202	3,289
	Minimum	3,343	3,253	3,713	2,432	1,574	1,327	1,974	2,126	783	2,159	1,663	1,344	783
1999	Maximum	6,610	6,679	6,594	5,253	5,808	6,119	6,773	7,140	4,202	3,368	6,990	5,670	7,140
	Average	5,588	6,362	5,447	4,371	4,348	4,702	6,070	5,595	3,342	3,138	5,130	3,967	4,843
	Minimum	2,751	5,946	4,050	3,180	3,335	3,095	4,698	3,590	142	1,379	1,944	2,284	142
2000	Maximum	6,889	6,070	5,266	4,244	3,377	5,991	6,005	4,452	3,825	3,335	5,425	4,635	6,889
	Average	6,008	5,293	4,443	3,313	2,627	2,963	4,856	3,270	3,150	3,063	3,650	3,144	3,813
	Minimum	4,679	4,704	3,983	2,877	1,759	1,453	3,541	1,946	1,979	1,824	2,919	2,120	1,453
2001	Maximum	4,258	2,668	2,557	2,427	2,498	1,983	2,964	4,012	3,524	2,913	3,169	4,074	4,258
	Average	2,555	2,205	2,247	1,773	1,406	1,190	2,236	3,432	2,566	2,259	2,282	2,812	2,251
	Minimum	1,453	1,795	1,899	1,299	861	788	837	2,835	1,419	1,577	1,166	2,013	788

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2002	Maximum	6,825	6,806	6,781	5,771	6,703	6,838	6,839	4,175	3,746	3,166	3,110	3,110	6,839
	Average	5,884	5,695	6,075	4,264	5,360	5,346	6,456	3,282	2,482	2,112	2,397	1,969	4,272
	Minimum	2,490	3,746	4,569	1,561	3,431	2,682	3,596	2,560	1,609	1,459	1,643	1,466	1,459
2003	Maximum	5,440	6,209	4,544	4,115	3,861	6,361	5,533	3,941	3,612	3,316	3,277	4,244	6,361
	Average	4,251	3,942	3,072	3,508	3,365	4,151	3,650	3,077	2,957	2,983	3,166	3,585	3,472
	Minimum	2,045	2,047	1,350	2,790	2,433	2,336	2,727	2,093	2,310	2,029	2,768	2,858	1,350
2004	Maximum	6,675	6,648	4,650	2,833	2,113	6,662	6,148	4,742	3,764	5,893	6,734	6,576	6,734
	Average	5,449	6,204	2,506	2,451	1,746	3,447	3,533	3,209	3,018	3,412	4,966	4,039	3,653
	Minimum	3,361	3,759	2,088	2,059	1,430	1,347	2,244	1,756	1,993	2,203	2,893	1,745	1,347
2005	Maximum	6,668	6,566	3,982	2,438	2,737	2,458	2,700	2,283	3,168	4,435	6,411	4,397	6,668
	Average	5,533	4,946	2,687	2,086	2,149	1,963	2,099	1,976	2,736	2,936	5,077	3,698	3,145
	Minimum	2,515	3,862	2,137	1,580	1,572	1,638	1,257	1,138	2,119	1,481	3,826	1,889	1,138
2006	Maximum	6,670	7,023	7,035	2,704	3,229	3,549	5,443	2,406	2,885	2,328	7,110	4,217	7,110
	Average	5,127	6,144	5,736	2,172	2,184	2,644	3,526	2,010	2,564	1,749	5,736	3,577	3,580
	Minimum	2,210	3,880	2,628	1,453	1,706	2,166	2,322	1,820	1,928	1,458	1,398	2,525	1,398
2007	Maximum	6,838	6,568	6,618	5,725	4,533	3,323	3,267	3,162	3,032	6,318	4,079	4,194	6,838
	Average	5,767	6,094	5,614	4,934	3,201	3,287	3,223	2,493	2,680	3,367	3,275	3,588	3,947
	Minimum	3,913	4,999	3,174	3,916	2,563	3,240	3,155	1,876	2,071	2,081	3,027	3,217	1,876
2008	Maximum	6,922	6,653	6,294	3,645	3,217	5,305	6,983	4,789	4,024	3,385	4,240	3,978	6,983
	Average	5,352	4,967	4,333	3,100	2,210	2,531	4,928	3,175	3,204	3,023	3,070	3,471	3,613
	Minimum	3,882	2,868	2,870	2,678	1,521	1,330	2,601	1,666	2,789	1,465	1,690	2,632	1,330
2009	Maximum	4,564	4,770	2,941	3,205	2,655	6,958	5,289	4,601	3,969	5,119	7,124	5,929	7,124
	Average	3,435	3,731	2,581	2,624	1,818	4,369	3,778	2,634	2,475	2,631	5,782	4,433	3,349
	Minimum	2,303	2,434	2,336	1,697	1,088	1,768	2,216	1,996	1,751	1,708	2,554	3,408	1,088
2010	Maximum	4,935	5,239	3,135	3,151	2,944	6,501	7,056	3,987	4,034	7,119	3,903	3,944	7,119
	Average	3,930	3,633	2,857	2,862	2,609	3,495	5,511	2,814	2,915	4,813	3,102	3,194	3,481
	Minimum	3,150	2,493	2,563	2,565	2,130	2,023	3,719	1,992	1,426	2,028	2,232	2,578	1,426
2011	Maximum	6,595	6,840	6,609	4,983	4,230	6,560	6,909	6,808	3,963	3,674	5,855	4,085	6,909
	Average	4,849	6,142	5,584	4,112	3,596	4,710	6,437	4,358	3,376	3,123	3,848	3,649	4,474
	Minimum	2,814	5,087	3,950	2,600	2,472	2,785	4,914	583	2,404	2,604	563	2,913	563

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2012	Maximum	5,306	6,560	6,542	4,196	5,352	7,260	7,342	5,863	3,100	3,976	7,269	4,757	7,342
	Average	4,595	6,062	4,850	3,207	4,409	5,795	6,381	3,897	2,731	2,815	5,361	4,327	4,530
	Minimum	2,827	5,375	2,865	1,759	3,264	3,823	3,886	2,305	1,921	1,499	3,826	3,746	1,499
2013	Maximum	7,040	6,356	4,480	4,197	4,002	6,105	5,451	4,427	4,101	5,241	4,148	4,449	7,040
	Average	5,747	4,997	3,638	3,525	3,122	4,285	3,961	3,129	3,309	4,235	3,647	4,015	3,962
	Minimum	4,581	4,409	2,880	2,683	2,201	3,360	2,410	2,085	2,524	2,986	3,029	3,412	2,085
2014	Maximum	4,041	5,095	4,771	4,949	4,167	7,149	7,087	4,116	3,407	4,801	6,982	6,931	7,149
	Average	3,634	3,984	4,059	4,459	3,221	5,122	5,675	3,115	3,186	3,172	5,114	5,022	4,145
	Minimum	3,061	3,449	2,145	3,716	2,703	3,029	3,083	2,229	2,680	2,500	2,268	3,794	2,145
2015	Maximum	6,577	6,894	6,807	3,607	2,709	3,944	3,116	2,457	4,076	3,971	5,260	5,775	6,894
	Average	5,771	6,216	4,706	3,269	2,437	2,980	2,808	1,346	3,499	3,604	4,076	4,995	3,793
	Minimum	3,799	2,562	3,465	2,127	2,115	2,133	2,567	12	2,185	3,139	2,147	2,846	12
2016	Maximum	6,662	6,554	6,548	4,342	5,636	5,272	5,349	3,084	4,172	5,274	4,842	6,754	6,754
	Average	5,908	5,575	5,467	3,793	4,212	3,876	3,563	2,535	3,474	3,779	3,574	4,311	4,170
	Minimum	3,807	2,715	3,872	2,686	3,061	2,811	2,845	1,810	2,129	2,553	2,651	3,624	1,810
2017	Maximum	6,948	3,813	6,803	3,574	3,569	8,838	5,794	3,931	4,183	4,771	9,131	12,456	12,456
	Average	5,042	2,892	3,875	3,369	2,918	5,500	4,240	2,817	3,326	3,399	4,422	4,918	3,899
	Minimum	2,477	1,932	782	2,934	24	3,420	3,100	1,577	1,384	2,747	2,767	3,565	24
2018	Maximum	6,235	10,401	11,160	3,285	4,136	3,667	4,737	3,998	3,914	3,957	4,741	3,953	11,160
	Average	5,198	7,205	6,466	2,903	2,794	3,056	3,149	2,715	3,553	3,665	3,488	3,537	3,959
	Minimum	3,714	5,080	3,514	2,549	1,676	2,294	2,027	1,812	1,535	2,858	2,335	3,224	1,535

Table 4.4-3. Monthly minimum, average, and maximum outflows (cfs) from Gorge Lake (based on Newhalem gage data) (1991-2018).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	Maximum	7,270	15,800	7,240	7,620	6,150	6,470	17,400	7,260	6,960	3,590	5,730	4,360	17,400
	Average	6,101	10,191	6,653	5,888	5,846	4,927	9,684	5,615	3,644	2,920	3,387	3,654	5,686
	Minimum	4,050	6,870	3,800	3,780	5,560	3,240	5,220	3,230	2,810	2,110	1,940	2,680	1,940
1992	Maximum	6,650	7,410	7,310	4,920	3,350	3,400	5,830	4,630	3,190	5,120	5,340	4,260	7,410
	Average	5,918	6,817	5,513	3,590	2,326	2,642	4,505	3,611	2,259	2,842	4,389	3,597	3,994
	Minimum	3,930	5,950	3,780	2,030	2,040	2,150	2,640	2,240	1,610	1,700	3,660	2,030	1,610

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1993	Maximum	5,580	4,970	3,310	2,700	5,440	3,090	5,200	4,760	3,700	3,180	5,960	4,490	5,960
	Average	3,835	3,932	2,482	2,376	2,653	1,979	3,263	2,928	2,666	2,740	4,096	3,497	3,033
	Minimum	2,660	2,450	2,350	2,350	1,780	1,570	2,380	2,060	1,800	2,290	2,650	2,320	1,570
1994	Maximum	6,030	6,040	5,030	4,750	3,610	3,760	4,190	3,740	3,640	3,320	4,800	4,960	6,040
	Average	4,581	4,312	3,874	4,279	3,147	2,651	3,511	3,290	3,302	2,454	3,156	3,800	3,525
	Minimum	2,910	2,630	2,700	3,730	2,560	2,330	2,400	2,380	2,800	1,820	2,170	2,380	1,820
1995	Maximum	6,910	7,240	7,050	6,640	5,640	5,400	4,330	4,640	3,390	3,830	23,300	28,200	28,200
	Average	5,739	6,201	6,272	4,414	4,340	3,523	3,195	3,356	2,723	2,965	11,307	9,455	5,281
	Minimum	3,910	5,370	5,110	3,490	2,730	2,610	2,640	1,850	1,780	1,790	3,600	2,500	1,780
1996	Maximum	7,270	7,470	6,290	5,970	5,440	5,660	6,900	4,530	3,480	3,910	5,710	4,390	7,470
	Average	5,705	5,344	5,542	5,281	4,966	4,702	5,015	2,982	2,880	3,070	3,988	3,777	4,435
	Minimum	3,300	2,600	4,080	4,490	4,420	3,540	2,800	1,950	2,060	2,250	2,600	2,550	1,950
1997	Maximum	7,490	7,140	7,740	7,400	8,570	23,400	22,300	6,980	3,400	14,300	11,500	4,520	23,400
	Average	5,553	6,194	6,919	6,513	7,128	9,867	9,068	4,084	2,897	4,807	5,721	4,082	6,066
	Minimum	2,460	4,760	4,390	3,830	6,530	6,480	4,930	2,140	2,240	2,680	3,360	3,120	2,140
1998	Maximum	6,720	5,210	5,890	5,360	3,410	3,150	6,450	4,620	4,300	3,570	4,240	5,330	6,720
	Average	5,256	4,354	4,803	4,497	2,636	2,649	3,896	3,223	3,197	3,070	3,267	3,776	3,717
	Minimum	3,730	3,680	4,220	3,190	2,390	2,350	2,520	2,280	1,810	2,420	2,070	2,360	1,810
1999	Maximum	6,930	6,810	6,760	5,500	6,620	6,920	13,800	14,000	4,450	4,400	15,000	6,190	15,000
	Average	6,035	6,586	5,681	4,732	4,993	5,521	8,425	7,202	3,838	3,771	7,408	4,528	5,723
	Minimum	3,400	6,360	4,360	3,850	4,050	4,380	5,830	4,180	3,440	3,420	3,560	3,280	3,280
2000	Maximum	7,100	6,490	5,540	4,690	3,720	6,890	6,800	5,880	4,360	4,630	5,790	5,030	7,100
	Average	6,297	5,631	4,786	3,842	3,248	3,854	5,535	3,854	3,473	3,298	3,841	3,405	4,253
	Minimum	5,170	5,000	4,280	3,170	2,510	2,460	4,330	2,260	2,420	1,880	2,950	2,330	1,880
2001	Maximum	4,590	2,720	2,630	2,490	4,080	2,190	3,200	4,240	3,650	3,120	6,050	4,150	6,050
	Average	2,877	2,413	2,436	2,060	2,003	1,752	2,645	3,762	2,795	2,587	2,925	3,214	2,627
	Minimum	2,410	2,200	2,390	2,000	1,600	1,600	1,610	3,380	1,640	1,760	1,870	2,350	1,600
2002	Maximum	9,460	7,410	7,160	6,060	7,000	9,870	14,400	4,620	4,100	3,530	3,340	3,310	14,400
	Average	6,526	6,190	6,462	4,835	6,003	6,431	8,378	3,496	2,577	2,254	2,689	2,249	4,838
	Minimum	2,630	5,470	5,040	3,030	3,840	3,560	3,530	2,610	1,760	1,800	1,850	1,950	1,760
	Maximum	6,740	6,540	4,880	4,540	4,340	7,160	6,390	4,220	3,810	32,700	8,600	7,670	32,700

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2003	Average	5,050	4,327	3,670	3,987	3,964	4,880	4,062	3,307	3,163	7,609	6,083	4,139	4,522
	Minimum	2,450	2,570	2,430	3,280	3,370	2,880	3,050	2,330	2,410	2,580	2,460	3,450	2,330
	Maximum	7,380	7,290	4,760	3,140	2,700	10,700	6,620	4,930	4,170	6,320	7,350	7,510	10,700
2004	Average	6,051	6,749	2,950	2,950	2,399	4,429	3,912	3,521	3,569	3,760	5,737	4,797	4,222
	Minimum	3,670	4,010	2,760	2,780	2,150	2,120	2,760	2,290	2,320	2,730	3,870	3,870	2,120
	Maximum	10,500	7,180	4,040	2,590	2,920	2,700	2,730	2,490	4,750	4,820	7,200	4,630	10,500
2005	Average	6,400	5,299	2,914	2,459	2,547	2,284	2,369	2,218	2,971	3,345	5,670	4,267	3,550
	Minimum	3,780	4,170	2,510	2,400	2,000	2,110	2,090	2,140	2,380	2,120	4,320	2,810	2,000
	Maximum	7,660	7,160	7,250	3,020	6,040	4,260	6,050	2,810	3,040	2,420	25,100	4,580	25,100
2006	Average	5,928	6,629	6,005	2,620	2,998	3,466	4,067	2,232	2,724	1,911	8,812	4,085	4,269
	Minimum	2,780	4,020	2,850	2,390	2,240	2,930	2,720	2,150	1,970	1,700	2,170	3,250	1,700
	Maximum	7,160	7,040	9,950	6,240	5,260	10,000	11,500	3,530	3,310	7,050	4,530	8,020	11,500
2007	Average	6,359	6,690	6,725	5,622	4,006	7,084	7,237	2,811	2,950	4,230	3,901	4,422	5,160
	Minimum	4,360	5,620	3,740	4,430	3,530	4,940	3,640	2,280	2,410	3,060	3,490	3,720	2,280
	Maximum	7,590	7,340	6,920	4,160	6,680	7,010	15,600	5,220	4,340	3,690	4,590	4,570	15,600
2008	Average	5,952	5,614	4,971	3,591	3,476	3,429	6,727	3,803	3,632	3,514	3,912	3,970	4,384
	Minimum	4,460	3,390	3,650	3,100	2,370	2,330	3,080	2,190	3,020	1,880	1,910	3,070	1,880
	Maximum	6,300	5,480	3,490	3,700	4,200	9,690	6,080	5,900	4,440	6,910	11,300	7,330	11,300
2009	Average	4,114	4,226	2,982	3,193	2,637	5,661	4,450	3,010	2,808	3,261	7,445	5,105	4,066
	Minimum	2,880	2,970	2,840	2,750	2,060	2,820	2,850	2,270	2,270	2,580	4,810	4,150	2,060
	Maximum	5,550	5,810	3,690	3,570	3,500	7,580	8,370	4,480	4,400	7,920	4,710	6,230	8,370
2010	Average	4,674	4,114	3,310	3,405	3,320	4,526	6,515	3,304	3,562	5,463	3,773	3,929	4,162
	Minimum	3,530	3,130	3,030	3,140	2,760	3,040	4,610	2,280	1,780	2,260	2,720	2,940	1,780
	Maximum	8,220	7,730	7,510	5,710	4,980	7,870	11,100	8,680	4,490	4,310	6,810	4,560	11,100
2011	Average	5,924	7,090	6,441	4,787	4,523	5,999	8,494	5,566	3,949	3,767	4,720	4,240	5,451
	Minimum	4,060	6,070	5,120	3,050	3,080	3,710	5,920	3,840	3,310	2,900	3,360	3,430	2,900
	Maximum	6,250	7,280	7,330	5,000	6,210	13,200	13,700	6,830	3,370	6,220	10,500	5,270	13,700
2012	Average	5,400	6,831	5,546	4,062	5,565	8,665	10,011	4,572	3,100	3,741	7,222	4,998	5,804
	Minimum	3,350	6,430	3,410	2,770	4,580	5,400	4,920	2,700	2,180	3,090	4,840	4,700	2,180
	Maximum	7,770	7,120	5,230	4,920	5,540	7,060	6,320	5,080	6,940	8,460	4,410	4,880	8,460
2013	Average	6,448	5,641	4,413	4,515	4,354	5,393	4,935	3,656	4,192	5,735	4,207	4,604	4,837

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	Minimum	5,220	5,060	3,810	3,770	3,720	4,540	3,070	2,430	2,910	3,910	3,600	4,350	2,430
2014	Maximum	4,650	5,780	5,620	5,690	5,670	13,200	12,300	4,740	3,780	6,230	12,400	14,506	14,506
	Average	4,365	4,601	5,035	5,309	5,213	7,563	8,201	3,617	3,651	3,992	6,605	7,054	5,437
	Minimum	4,020	4,120	4,350	4,570	4,480	5,370	4,220	2,550	3,020	3,510	4,400	4,474	2,550
2015	Maximum	7,402	7,931	7,572	3,990	3,300	4,430	3,330	3,790	4,490	5,730	6,420	6,960	7,931
	Average	6,838	7,332	5,594	3,849	3,044	3,534	3,250	2,355	4,091	4,248	5,227	5,963	4,593
	Minimum	4,606	6,254	4,621	3,100	2,830	2,930	3,110	2,190	3,410	3,630	4,130	5,410	2,190
2016	Maximum	7,980	7,590	7,660	5,040	6,400	6,660	6,270	3,510	4,550	7,860	10,800	7,390	10,800
	Average	6,975	6,698	6,397	4,738	5,159	5,042	4,169	2,870	3,925	5,339	5,454	4,879	5,132
	Minimum	5,880	3,870	4,470	3,520	3,960	3,800	3,560	2,200	2,410	4,110	4,020	4,280	2,200
2017	Maximum	7,640	4,690	7,630	6,180	6,650	10,800	6,890	4,490	4,540	7,590	14,900	12,800	14,900
	Average	5,647	3,645	5,132	5,370	6,298	7,489	5,063	3,237	3,734	4,021	5,546	5,507	5,064
	Minimum	2,950	2,960	3,650	4,140	5,540	5,480	3,830	1,800	1,670	3,530	3,600	4,250	1,670
2018	Maximum	7,140	12,400	12,300	4,250	6,240	4,470	5,780	4,670	4,560	4,560	6,430	5,280	12,400
	Average	6,040	8,805	7,451	3,722	4,226	4,179	3,958	3,210	4,191	4,420	4,617	4,348	4,907
	Minimum	4,580	7,120	4,020	3,510	2,670	2,940	2,910	2,210	1,810	4,270	4,140	3,050	1,810

4.4.2.3 Flow Duration Curves

Annual flow duration curves for Ross Lake, Diablo Lake, and Gorge Lake outflows (1991-2018) are provided in Figures 4.4-3 through 4.4-5. Monthly flow duration curves for the same locations and period are appended to this PAD. Dependable capacity for the Project is discussed in Section 3.5.3.1.

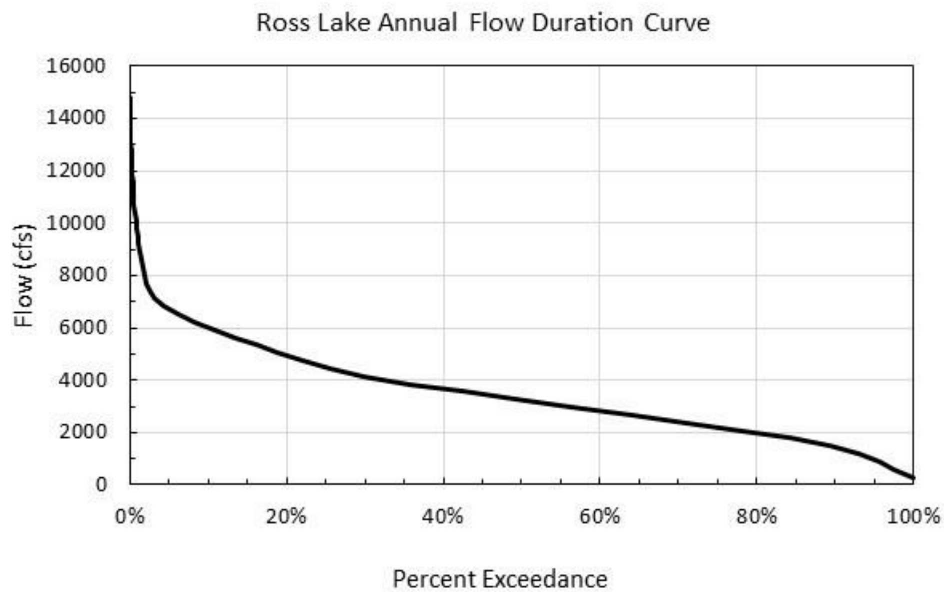


Figure 4.4-3. Annual flow duration curve for Ross Lake outflows (1991-2018).

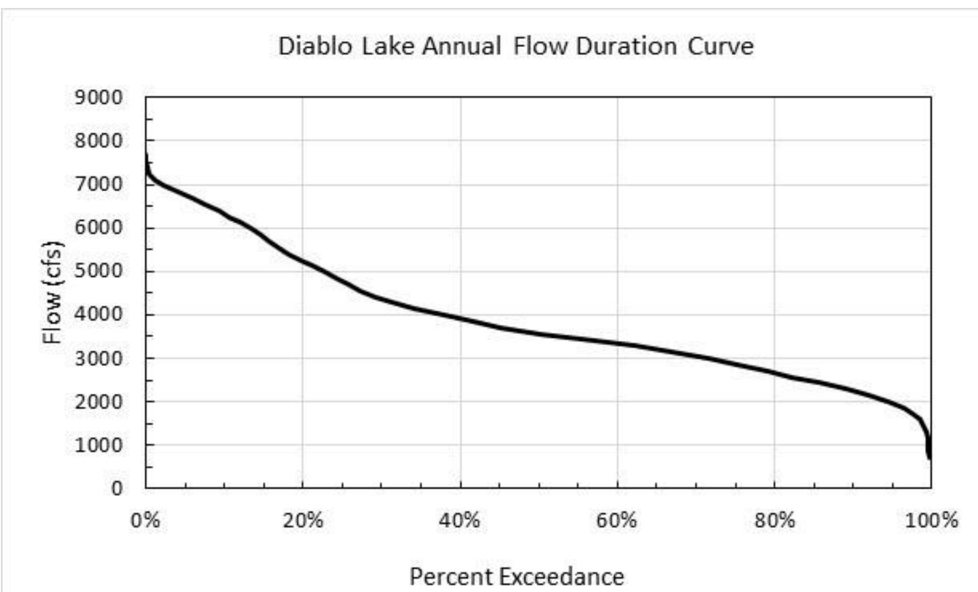


Figure 4.4-4. Annual flow duration curve for Diablo Lake outflows (1991-2018).

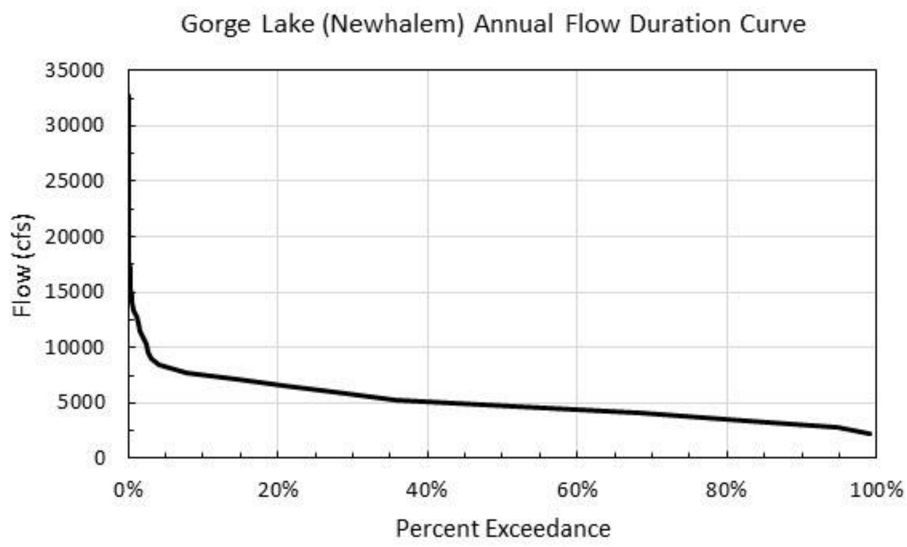


Figure 4.4-5. Annual flow duration curve for Gorge Lake outflows (Newhalem gage) (1991-2018).

4.4.2.4 Reservoir Surface Elevation Curves

Annual percent exceedance curves of water surface elevations for Ross Lake, Diablo Lake, and Gorge Lake, from 1991 to 2018, are provided in Figures 4.4-6 through 4.4-8. These illustrate the role of Ross Lake for storage and flood control and the relative stability of the other two reservoirs. See Section 3.5 of this PAD for more detail on reservoir operations.

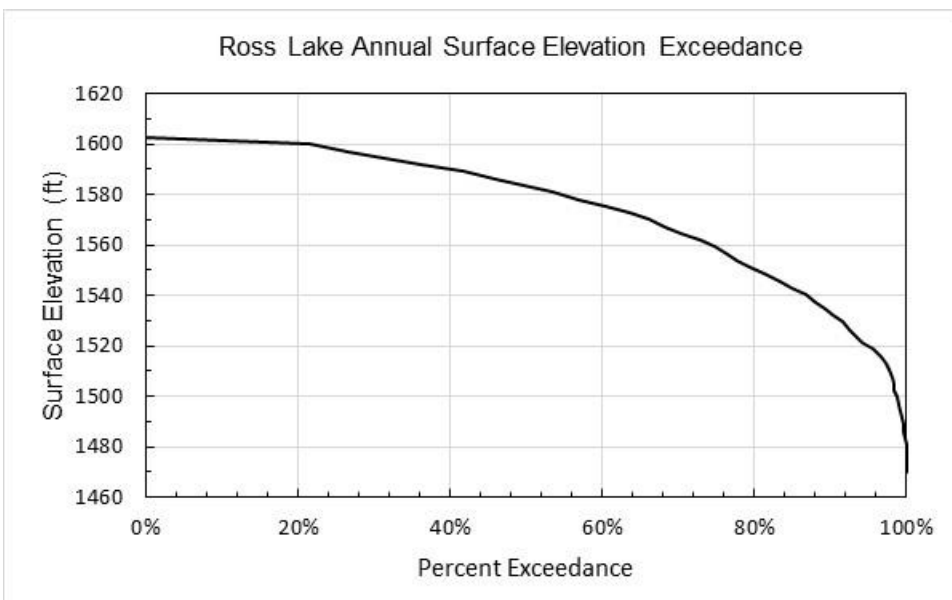


Figure 4.4-6. Annual percent exceedance curve of water surface elevations for Ross Lake, based on the period 1991-2018.

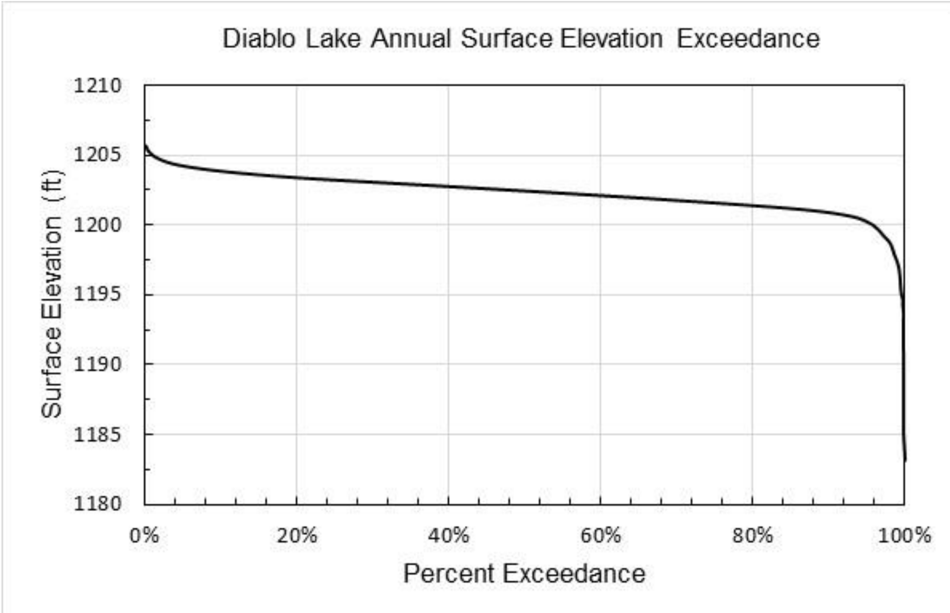


Figure 4.4-7. Annual percent exceedance curve of water surface elevations for Diablo Lake, based on the period 1991-2018.

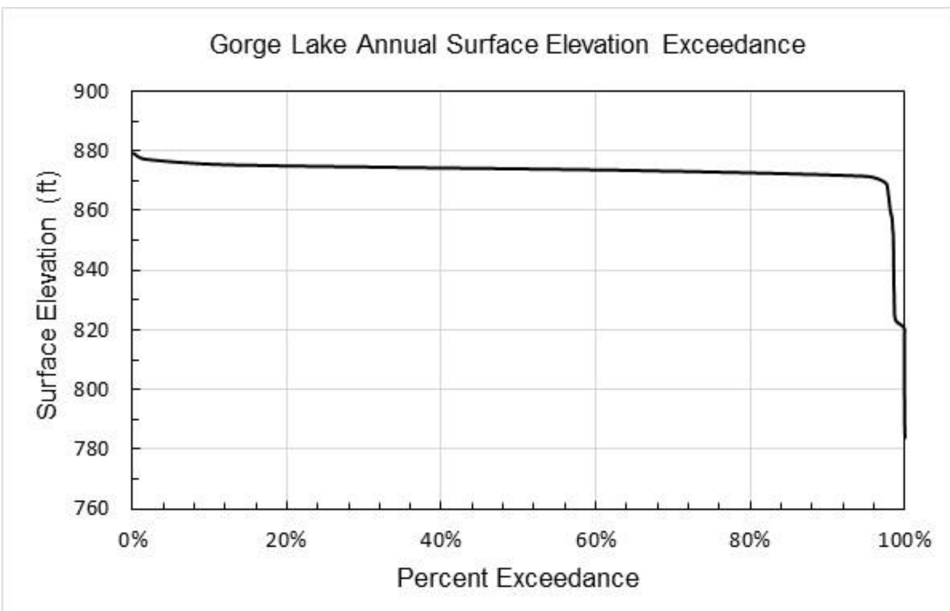


Figure 4.4-8. Annual percent exceedance curve of water surface elevations for Gorge Lake, based on the period 1991-2018.

4.4.3 Existing and Proposed Water Uses

Designated uses established by the state of Washington (Washington Administrative Code [WAC] 173-201A-030) for the Skagit River and its tributaries in the Project vicinity are shown in Table 4.4-4.

Table 4.4-4. Designated uses of water in the Skagit River and designated Water Resources Inventory Area (WRIA) 4 tributaries.

Water Body	Aquatic Life Uses						Recreational Uses			Water Supply Uses				Misc. Uses				
	Char Spawning/Rearing	Core Summer Habitat	Spawning/Rearing	Rearing/Migration Only	Redband Trout	Warm Water Species	Ex Primary Contact	Primary Contact	Secondary Contact	Domestic Water	Industrial Water	Agricultural Water	Stock Water	Wildlife Habitat	Harvesting	Commerce/Navigation	Boating	Aesthetics
Skagit River and all tributaries upstream of Skiyou Slough except designated tributaries		✓	✓[2]					✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Designated WRIA 4 tributaries[1]	✓							✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: WAC 173-201A-602.

1 Bacon Cr, Big Beaver Cr, Cascade R, Diobsud Cr, Goodell Cr, Hozomeen Cr, Illabot Cr, Lightning Cr, Little Beaver Cr, Newhalem Cr., Rocky Cr, Ruby Cr, Sauk R, Silver Cr, Stetattle Cr, and Thunder Cr.

2 See supplemental spawning and incubation map (Figure 4.4-9).

Designated uses for waterbodies in Table 4.4-4 were taken from WAC 173-201A-602, Water Quality Standards for Surface Waters of the State of Washington, Table 602 (Use designations for fresh waters by WRIA). Ross Lake is not addressed in Table 602. However, in accordance with WAC 173-201A-600, designated uses that apply to WRIA-4 waterbodies not listed in Table 602 include primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values. In addition, the designated use of Core Summer Habitat for salmonids applies to "all surface waters lying within national parks, national forests, and/or wilderness areas," as well as "[a]ll lakes and feeder streams to lakes," including reservoirs with a mean detention time greater than 15 days. Ross Lake is treated as a lake for this purpose. Diablo and Gorge lakes are considered riverine reaches by Ecology and as such the Skagit River uses shown in Table 4.4-4 apply to these two waterbodies.

4.4.3.1 Water Rights in the Project Vicinity

The Project is in the Upper Skagit River WRIA 4, which has an Instream Resources Protection Program rule (WAC 173-503), often referred to as the Skagit instream flow rule, effective as of April 14, 2001. The instream flow rule protects minimum flows in the Skagit River thereby maintaining a healthy aquatic ecosystem. This rule, required by state law (Revised Code of Washington [RCW] 90.54), applies to the entire upper Skagit River basin, and new water uses that could impact the Skagit River must be mitigated to prevent impairment of instream flows. Water uses established after the rule are interruptible when the river's minimum flows are not met, i.e., junior water rights can be forced to shut off until the river's senior water rights are fulfilled.

With the exception of two rights held by other government agencies and one private water right, City Light holds the only water rights in the upper Skagit River in the vicinity of the Project, all of which are senior to the Skagit Instream Flow rule. City Light has two pending water right applications on file with Ecology: (1) 6,500 cfs power discharge at Ross Dam, which will bring the full discharge into alignment with the nameplate capacity of 16,000 cfs, and (2) de facto change of use from Happy Creek (S1-*04465CWRIS) to the Ross Dam power intake for the existing domestic supply at Ross Dam. Both these rights are for non-consumptive uses.

Currently City Light does not anticipate applying for new consumptive uses of surface water or groundwater during the next license term. In 2019, City Light authorized the Washington Water Trust to apply for and be the holder of a water right permit for secondary use of 362 acre-feet per year of water released from Gorge Lake. City Light's storage in Gorge Lake (under Record locator R1-*13081CWRIS) is the primary use of the water release. The secondary use permit, issued by Ecology on February 5, 2020, authorizes beneficial use of the water release for Skagit River instream flow augmentation and mitigation purposes, and is based on 0.5 cfs continuous discharge diverted from the penstock immediately upstream of Gorge Powerhouse. By agreement between Ecology, City Light, and the Washington Water Trust, the 362-acre-feet per year water release will be placed in the State’s Trust Water Rights Program in perpetuity after one year of perfection. Water rights in the vicinity of the Project, on file with Ecology’s Water Resources Section, are shown in Table 4.4-5.

Table 4.4-5. Water rights in the vicinity of the Skagit River Hydroelectric Project, on file with Ecology's Water Resources Section (cfs = cubic feet per second; gpm = gallons per minute; ac-ft/yr = acre-feet per year).

Water Rights					Amount of Appropriation			
Record Number	Location/ Development	Water Right Holder/Applicant	Priority Date	Purposes	Instantaneous	Annual (ac-ft/yr)	Status[1]	Source
S1-*00433CWRIS	Gorge	City Light	06/07/1920	Power	3,500 cfs	--	In Use	Skagit River
S1-*00632CWRIS	Gorge	City Light	07/21/1920	Domestic Supply	20 cfs		--	Ladder Creek
S1-*02644CWRIS	Gorge	City Light	07/20/1929	Power	1,000 cfs	--	In Use	Skagit River
G1-00489CWRIS	Newhalem	City Light	12/13/1971	Domestic Supply	600 gpm	312	In Use	Groundwater
G1-23722CWRIS	Newhalem	City Light	11/26/1980	Domestic Supply	200/600 gpm	21/312	In Use	Groundwater
S1-*02645CCWRIS	Diablo	City Light	07/20/1929	Power	4,200 cfs	--	In Use	Skagit River
S1-*03987CWRIS	Diablo	City Light	06/16/1934	Domestic Multiple	1.78 cfs	--	--	Pyramid Creek
S1-*16925CWRIS	Diablo	City Light	09/25/1961	Power	3,000 cfs	--	In Use	Skagit River
S1-*16926CWRIS	Gorge	City Light	09/25/1961	Power	3,000 cfs	--	In Use	Skagit River
G1-00490ALCWRIS	Diablo	City Light	12/13/1971	Domestic Multiple	300 gpm	90	In Use	Groundwater
S1-00742CWRIS	Ross	City Light	06/07/1920	Power	3,500 cfs	--	In Use	Ross Lake
S1-*04465CWRIS	Ross	City Light	09/17/1937	Domestic Multiple	5 cfs	--	Change of Use Pending	Happy Creek
S1-00741CWRIS	Ross	City Light	09/25/1961	Power	6,000 cfs	--	In Use	Ross Lake
S1-27546	Ross	City Light	10/04/1994	Power	6,500 cfs	--	Application Pending	Skagit River
S1-27751	Ross	City Light	07/11/1996	Municipal	0.08 cfs	55	Application Change of Use Pending	Ross Lake
CS1-*04465CWRIS	Ross	City Light	05/27/2016	Domestic	0.5 cfs	--	Application Change of Use Pending	Ross Lake
S1-*00394CWRIS	Newhalem Creek	City Light	03/10/1920	Power	75 cfs		In Use	Newhalem Creek
S1-*18374CWRIS	Avalanche Creek	US Forest Service Mount Baker	03/04/1964	Domestic Multiple	0.1 cfs	--	Unknown	Avalanche Creek
S1-047905CL	Hozomeen Creek	WA State Department of Game	Not Indicated	Domestic General	Not Indicated	--	In Use	Hozomeen Creek

Water Rights					Amount of Appropriation			
Record Number	**Location/ Development**	**Water Right Holder/Applicant**	**Priority Date**	**Purposes**	**Instantaneous**	**Annual (ac-ft/yr)**	**Status[1]**	**Source**
S1-*00532CWRIS	Stetattle Creek	Davis F E	11/22/1920	Domestic Single/ Power/Irrigation	5.5 cfs	--	--	Stetattle Creek
Reservoir Storage Rights								
R1-*13081CWRIS	Gorge	City Light	08/17/1954	Reservoir Storage (Gorge)	--	8,350	In Use	Skagit River
R1-*01592AWCWRIS	Diablo	City Light	01/12/1926	Reservoir Storage (Diablo)	--	90,000	In Use	Ruby Creek[2], Thunder Creek, Skagit River[2]
R1-135	Ross	City Light	11/06/1926	Reservoir Storage (Ross)	--	3,800,000	In Use, Permitted	Skagit River

1 "In Use" means perfected and beneficially used.
2 When this water right was issued in 1926, Ruby Creek and the Skagit River were still sources for Diablo Lake because Ross Dam did not exist.

4.4.4 Groundwater

Little information is available on groundwater dynamics in the upper Skagit River, although general assumptions can be made about groundwater and hydrogeology based on known and observed geologic information. Some limited, localized data also exist from several piezometers and wells.

As described in Section 4.3 of this PAD, most valley bottom areas in the Project vicinity are predominated by alluvium. The shallow aquifer hydrogeology of the Project vicinity is likely predominated by these deposits, much of it relatively coarse along and underlying the Skagit River and its tributaries. Permeability and hydraulic conductivity are assumed to be relatively high in most areas, with a high degree of groundwater-surface water interaction therefore likely within the Project Boundary. Groundwater in upland areas discharges into tributaries and the mainstem river. Deep groundwater zones can be assumed to exist in bedrock fractures and voids, which may be somewhat discontinuous relative to shallow groundwater.

Drilling logs and testing from two domestic supply wells installed by City Light in Newhalem and Diablo (1956 and 1962, respectively) provide hydrogeologic information about the subsurface at the townsites. The borehole for the Diablo well was logged as predominantly sand and gravel down to bedrock encountered at 171 feet below ground surface. Pump testing the well at 500 gallons per minute resulted in 10 feet of drawdown. The borehole for the Newhalem well was logged as predominantly sand, gravel, and clay to 157 feet below ground surface, with no bedrock encountered. Pump testing the well at 600 gallons per minute resulted in 23 feet of drawdown.

Groundwater level data were collected from piezometers at five locations in the Hollywood area in Diablo between October 2012 and April 2013 (Hart Crowser 2013). Hydraulic conductivities determined from slug tests at these locations were typical for sand and sandy-gravel deposits (Hart Crowser 2013). Several of the piezometers were instrumented by SPU Geotechnical Engineering with pressure transducers to monitor groundwater fluctuations (SPU Geotechnical Engineering 2013). Groundwater measurements made in 2012-2013 show that groundwater levels ranged between 10 and 13 feet below ground surface and appeared to be directly influenced by fluctuations in Gorge Lake elevations, with relatively insignificant influence from rainfall (SPU Geotechnical Engineering 2013).

Some groundwater/surface water interaction along the Skagit River downstream of the Project has been observed in the USGS gage data. Records from the period May 2015 through the present show that at times flows measured at the Marblemount gage are lower than those at the upstream Newhalem gage. There are tributary inputs along this reach, so it is possible that the reach between Newhalem and Marblemount loses water (i.e., surface water to groundwater; i.e., influent) during some periods. From May 1, 2015 to the present there have been 11 months during which daily flows measured at the USGS gage at Marblemount (#12181000) were lower than those at the gage at Newhalem (#12178000) (Table 4.4-6). More analysis is required to verify whether and when flow losses are actually occurring.

Table 4.4-6. Periods during which daily flows (cfs) at the USGS Marblemount gage (#12181000) were lower than those at the USGS Newhalem gage (#12178000) (2015-2019).

Month and year	Range of flow loss (Marblemount flow minus Newhalem flow)	Number of days with flow losses
August 2015	-20 to -100 cfs	13
October 2015	-20 to -30 cfs	3
August 2016	-40 cfs	1
September 2016	-30 to -140 cfs	5
October 2016	-30 to -90 cfs	4
August 2017	-40 to -100 cfs	5
September 2017	-10 to -440 cfs	25
October 2017	-1- to -100 cfs	12
September 2018	-40 to -130 cfs	3
February 2019	-10 to -170 cfs	14
March 2019	-120 to -280 cfs	17

4.4.5 Water Quality

The Project is located within the Upper Skagit River WRIA 4, which includes the Skagit River upstream of Boyd Creek (48.5106, -121.8973), the Sauk River, the Cascade River, the Baker River and all associated tributary streams. The upper Skagit River watershed consists mainly of forested National Park and National Forest land, and as a result water quality is good within and downstream of the Project vicinity (FERC 2012). Water quality in areas potentially affected by the Project complies with the water quality standards established for the designated uses, as discussed below.

4.4.5.1 Applicable Water Quality Standards

Designated uses established by the state of Washington (WAC 173-201A-602) are discussed in Section 4.4.3 of this PAD. Water quality criteria for the Project vicinity are shown in Table 4.4-7, some of which differentiate between lakes/reservoirs and stream reaches as defined by Ecology (WAC 173-201A-600) as follows: "...reservoirs with a mean detention time greater than fifteen days are to be treated as a lake for use designation..." By this definition, riverine water quality criteria (Table 4.4-7) apply to Diablo (detention time = 9.4 days) and Gorge (detention time = 0.8 days) lakes. Ross Lake, with a detention time of 189.4 days, is subject to the lake criteria identified in Table 4.4-7. In addition to the criteria shown in the table, Ecology has identified supplemental spawning and incubation criteria for specific reaches within WRIA 4 (Figure 4.4-9). Finally, the Skagit River from Gorge Dam (RM 96.5) downstream to Gorge Powerhouse (i.e., bypass reach) has a special condition status under State water quality standards (WAC 173-201A-600): water temperatures are not to exceed 21ºC as a result of anthropogenic activities.

Ecology's current Clean Water Act Section 305(b) report and 303(d) list of impaired waters for the state of Washington was approved by EPA on July 22, 2016. Water bodies included on the 303(d) list require a plan that describes the impaired segment's Total Maximum Daily Load (TMDL) and measures to improve water quality in the segment.

The current EPA water quality assessment for WRIA 4 (Upper Skagit) also includes 2014 category listings for toxic substances[12] (based on fish tissue data) in Ross Lake. Ecology assigned a Category 1 (i.e., "water quality criteria are being met") value to all evaluated toxins. Ecology's website states, "Fish tissue data from the most recent year showed that the FTEC [fish tissue equivalent concentration][13] was met; therefore, the Assessment Unit [i.e., Ross Lake] meets the requirements for a Category 1 determination."

Table 4.4-7. Water quality criteria for the Project vicinity (except as shown in Figure 4.4-9).

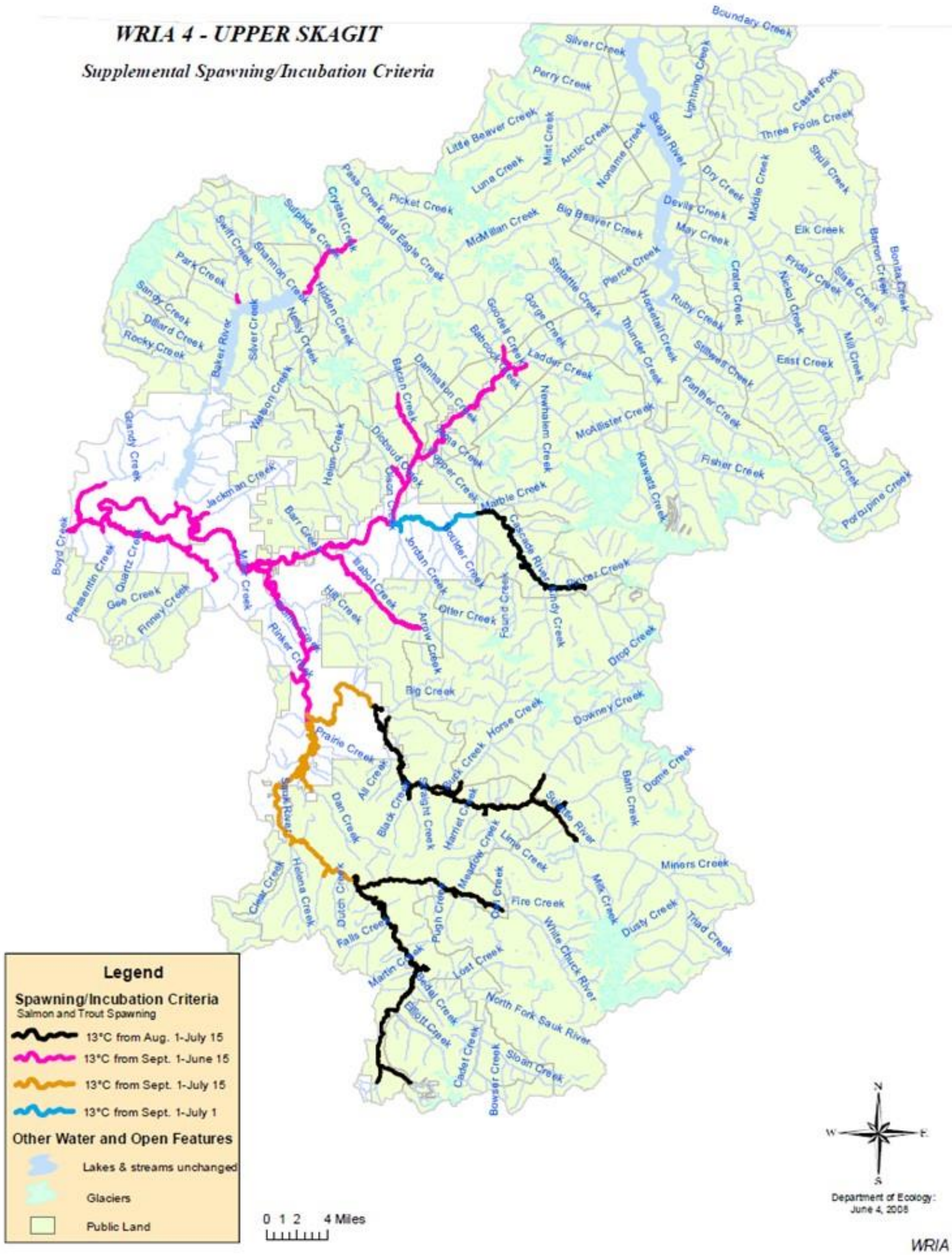
Parameter	Water Quality Criteria
Fecal Coliform[1]	Not to exceed a geometric mean value of 100 colony-forming units (CFU) or most probable number (MPN)/100 milliliter (mL) with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 200 CFU or MPN/100 mL.
E. coli	*E. coli* organism levels within an averaging period must not exceed a geometric mean value of 100 CFU or MPN per 100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained within the averaging period exceeding 320 CFU or MPN per 100 mL.
Dissolved Oxygen	Lowest 1-Day Minimum: Char Spawning and Rearing: 9.5 milligrams per liter (mg/L) Salmon and trout spawning, core rearing, and migration: 9.5 mg/L
	For lakes/reservoirs, human actions considered cumulatively may not decrease the dissolved oxygen concentration more than 0.2 mg/L below natural conditions.
Temperature	Maximum 7-day average of daily maximum temperature (7-DADMax): Char Spawning and Rearing: 12 degrees Celsius (°C)(53.6°F) Salmon and trout spawning (Sept. 1 to June 15): 13°C (55.4°F) Core summer salmonid habitat: 16°C (60.8°F)
	Skagit River from Gorge Dam to Gorge Powerhouse (Gorge bypass reach). Temperature shall not exceed a 1 day maximum temperature (1-DMax) of 21°C due to human activities. When natural conditions exceed a 1-DMax of 21°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C, nor shall such temperature increases, at any time, exceed $t = 34/(T + 9)$.
	For lakes/reservoirs, human actions considered cumulatively may not increase the 7- DADMax temperature more than 0.3°C (0.54°F) above natural conditions.
Total Dissolved Gas (TDG)	Not to exceed 110 percent of saturation at any point of sample collection.
pH	Within 6.5 to 8.5 pH units with human caused variation of: Less than 0.2 units for char and salmon and trout spawning, core rearing, and migration
Turbidity	Shall not exceed either a 5 nephelometric turbidity unit (NTU) increase over background when the background is 50 NTU or less; or a 10 percent increase in turbidity when the background is more than 50 NTU.

Source: WAC 173-201A-200.

1 The fecal coliform bacterial indicator expires on December 31, 2020.

[12] 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, Alpha-BHC, Beta-BHC, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, Hexachlorocyclohexane (Lindane), Toxaphene, Chlordane, 2,3,7,8-TCDD TEQ, 2,3,7,8-TCDD (Dioxin), Endosulfan, Aldrin.

[13] Per Ecology's website, "The FTEC is the concentration of a contaminant in fish tissue that Washington equates to the National Toxics Rule water quality criterion for the protection of human health."



Source: Ecology 2011.

Figure 4.4-9. Supplemental spawning and incubation protection temperature criteria for WRIA 4 Upper Skagit River basin.

Relative to State water quality standards, waterbodies in the Upper Skagit Basin WRIA 4 are in good condition. Based on Ecology (2014) there are currently no stream segments that have a prepared TMDL, and there are only three segments within WRIA 4 that are on the 303(d) list, i.e., shown as “Category 5” in Table 4.4-8, and these are not influenced by the Project and its operation. Ecology’s website provides the following statement regarding the segment of the Sauk River identified in Table 4.4-8; this segment is outside the influence of the Project and its operations, but has relevance as it provides significant inflow to the Skagit River downstream of the Project:

- Sauk River (Listing ID 72516): “In 2005, between 7/20/2005 and 8/31/2005, the 7-day mean of daily maximum [temperature] values (7-DADMax) exceeded the criterion for this waterbody (16°C) on 34 of 43 days (79%). The maximum exceedance during this period was 17.99°C for the 7-day period centered on 8/7/2005.”

Table 4.4-8. Relevant waterbodies/stream segments from the current EPA-approved water quality assessment list: WRIA 4 (Upper Skagit) including mainstem Skagit River and tributaries.

Parameter	Category[1]	Waterbody	Listing ID
Temperature	1	Skagit River	6564
	2	Diobsud Creek	74028
	5	Sauk River	72516
Dissolved Oxygen	2	Stetattle Creek, Goodell Creek	15453, 15455
	3	Skagit River	10568
pH	2	Newhalem Creek,	71171
	3	Skagit River, S.F. Cascade River	10567, 71170
Bacteria	1	Sauk River, Skagit River, Sauk River	16419, 16421, 46390
	5	Prairie Creek	42075
Mercury (tissue)	1	Sauk River, Ross Lake	79480, 79516
PCBs (tissue)	1	Ross Lake, Sauk River	78954, 78959
Instream Flow	4c	Newhalem Creek	6186
Ammonia-N	1	Skagit River, Sauk River, Sauk River	10563, 10569, 71722
Total Phosphorous	3	Gorge Lake	70671
Chloride	1	Newhalem Creek	77187
	3	Diobsud Creek, S.F. Cascade River,	77185, 77197

Source: Ecology 2014.

1 (1) Category 1: Water quality criteria are being met; (2) Category 2: Unconfirmed violations of the criteria; Sediment - confirmed violations of sediment criteria to a lesser extent than Category 5; (3) Category 3: Insufficient data/information to determine if the criteria are being met; (4) Category 4c: Impairment by a non-pollutant; TMDL development not required; (5) Category 5: 303(d) Listings - Confirmed violations of water quality criteria.

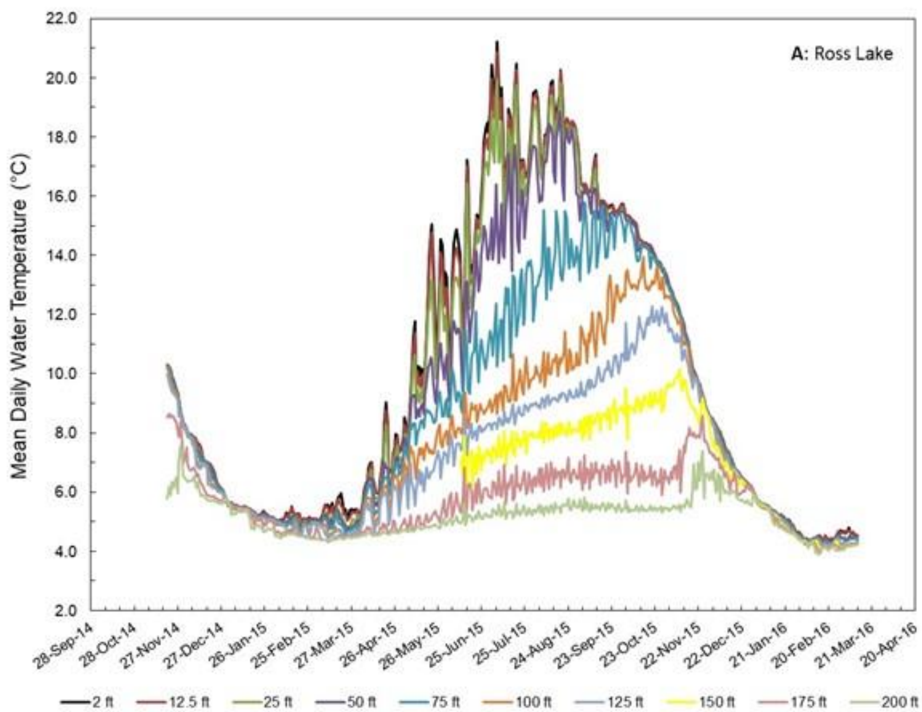
4.4.5.2 Existing Water Quality in the Project Vicinity

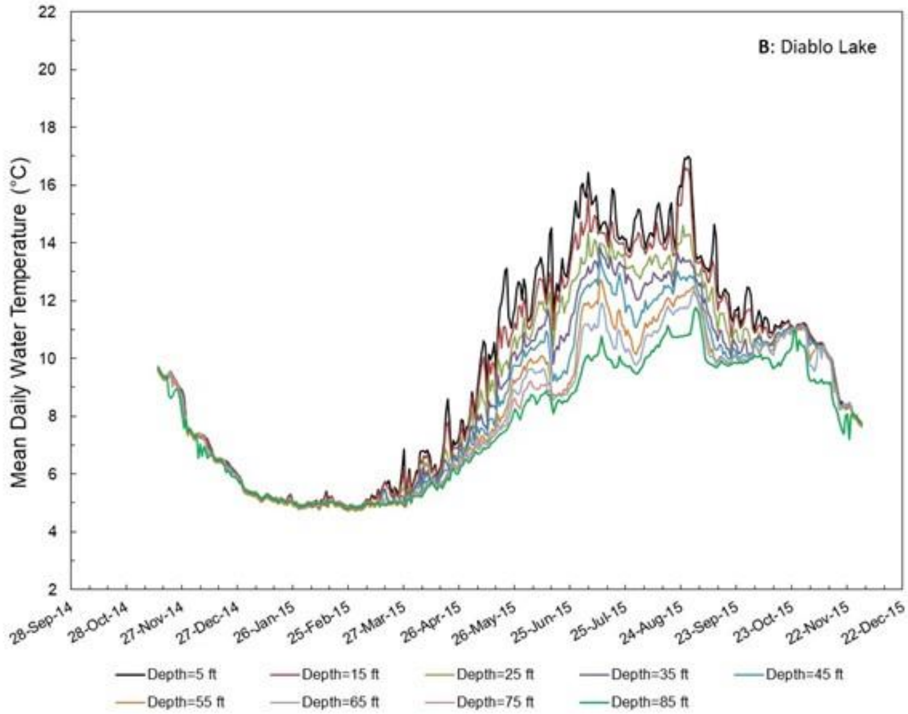
This section characterizes water quality in Ross, Diablo, and Gorge lakes, in the mainstem Skagit River downstream of the Project to the Sauk River confluence, and in select tributaries to Ross Lake. Water quality parameters addressed include: water temperature, dissolved oxygen, TDG, pH, bacteria, nutrients and productivity, conductivity, alkalinity, and select metals. Sampling results for riverine benthic macroinvertebrates (BMI) and reservoir zooplankton are also discussed.

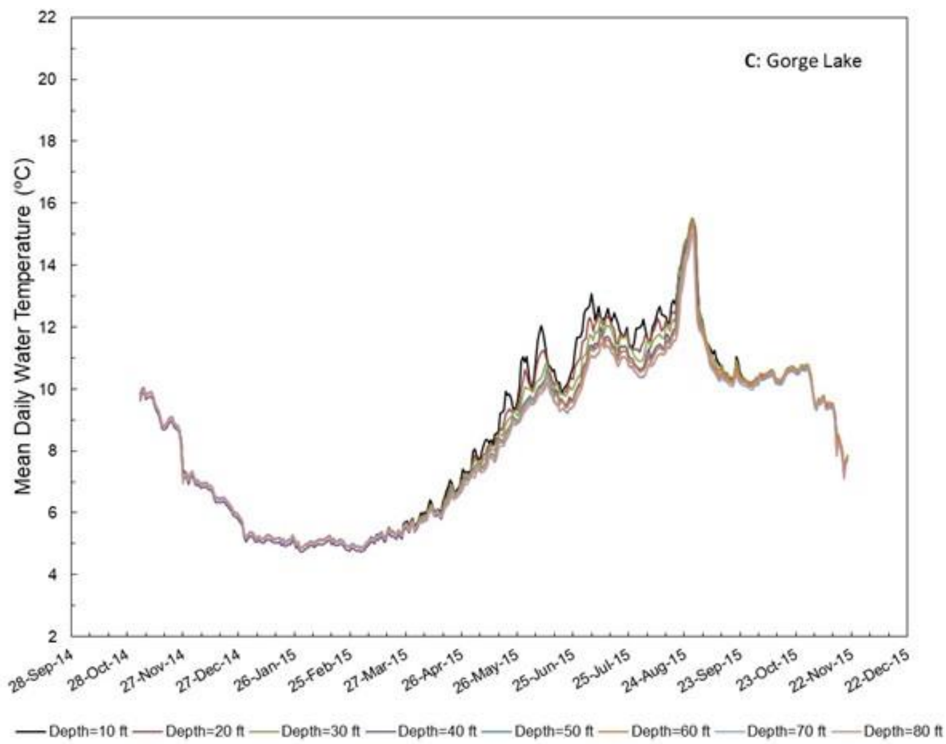
Water Temperature

Project Reservoirs

Warming patterns and surface water temperatures vary among the three Project reservoirs. Figures 4.4-10a through 4.4-10c show mean daily water temperatures measured at various depths at the log booms in each reservoir from fall 2014 through fall 2015/spring 2016. Moving in a downstream direction, water surface temperatures are highest in Ross Lake and successively lower in Diablo Lake and Gorge Lake. In addition, peak temperatures occur later in the season in the two downstream reservoirs. Figures 4.4-10a through 4.4-10c show that Ross Lake is the most stratified of the three reservoirs, and Gorge Lake is the least. Although stratified, Diablo Lake is cooler than Ross Lake in the upper portion of the water column; daily surface temperatures in Diablo Lake very rarely exceeded 16°C during the measurement period. Gorge Lake is weakly stratified during summer, which is expected given that detention time in this reservoir is less than one day. Daily surface water temperatures in Gorge Lake rarely exceeded 13°C during the measurement period.







Source: Connor 2019.

Figure 4.4-10a-c. Mean daily temperature (°C) measurements made at the log booms in each of the Project reservoirs (A: Ross Lake, B: Diablo Lake, C: Gorge Lake) from fall 2014 through winter 2015/spring 2016.

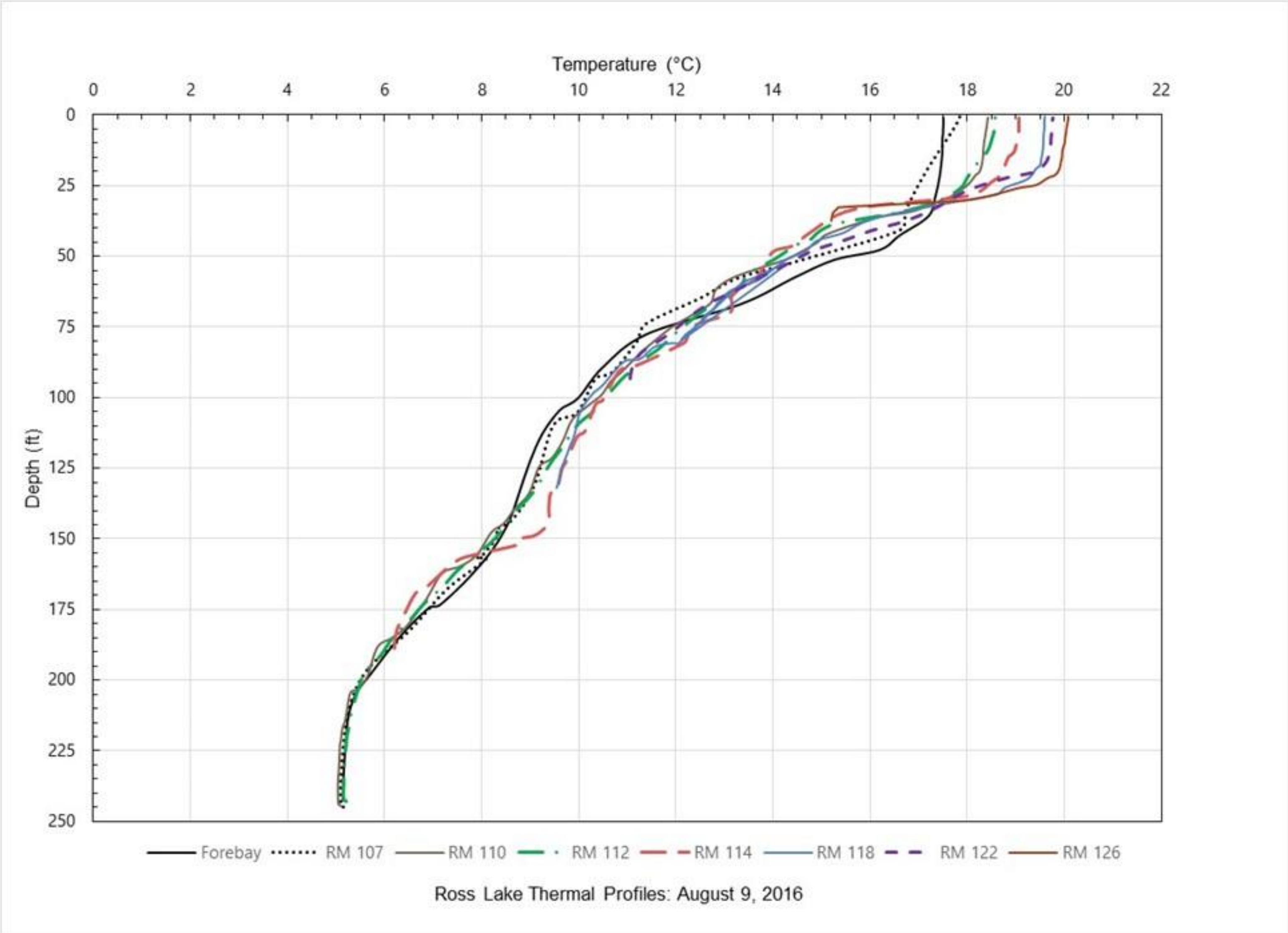
Ross Lake

Surface water temperatures in Ross Lake increase in summer, at which time a thermocline forms and the reservoir becomes stratified (about 95 percent of the reservoir's volume is below the thermocline). Thermal profile measurements made at multiple locations in Ross Lake during August 2016 are shown in Figure 4.4-11. There are two inflection points, one at around 30 feet and another, less pronounced point at around 160 feet. The reservoir is isothermal below about 200 feet. Except for the surface waters, the thermal profiles are similar from the southern to the northern end of the reservoir.

Temperatures measured along a depth profile in Ross Lake during 2017 (also at the log boom site) display similar patterns to those shown in Figure 4.4-10a. Mean daily surface temperatures were elevated in summer: the highest mean surface temperature, measured at a depth of 2 feet, was 20.8 degrees. However, deeper water remained cool during summer: at a depth of 75 feet, mean water temperatures exceeded 16°C on only 3 days, and between 100 feet and 200 feet mean temperatures never exceeded 13.6°C. The maximum temperature measured at 2 feet was 21.7°C (on August 3, 2017), and maximum surface water temperatures exceeded 16°C on 85 days. Previously collected data (from 2000-2002) also showed that Ross Lake stratifies during summer. At that time, however, maximum surface water temperature was 19.3°C, and temperatures below the thermocline were 10°C or less (R2 Resource Consultants 2009).

Ross Lake, with a detention time of 189.4 days, is subject to the lake criterion for temperature identified in Table 4.4-7, i.e., human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3°C (0.54°F) above natural conditions. Additionally, WAC 173-201A-200(1)(c)(vi) provides that temperature measurements should be taken to represent the "dominant aquatic habitat" of the monitoring site, which "typically" would not include the reservoir's surface. Although temperature data for Ross Lake provided in this PAD are mean daily statistics, not the 7-DADMax, Ross Lake temperatures appear to be in compliance with the State's criterion. Temperatures in the "dominant aquatic habitat," i.e., the vast majority of the water column, provide suitable temperatures for salmonids throughout the year, and elevated temperatures near the surface are not due to any identifiable human-caused impacts. Temperature dynamics, i.e., thermal stratification, higher surface temperatures, and abundant cold water at depth, are patterns typical of relatively large, deep natural lakes.

Water temperature data collected in select tributaries to Ross Lake (i.e., Big Beaver Creek, Lightning Creek, Little Beaver Creek, Ruby Creek, Silver Creek, and the Skagit River just north of its inflow into Ross Lake) are summarized in Table 4.4-9. The Skagit River at Swing Bridge site is in Canada, and maximum water temperatures at this location exceeded 13ºC in July 2014 and 14ºC in August 2014. Summer 7-DADMax temperatures in some of the tributaries for which data are available exceeded Ecology's applicable Char Spawning/Rearing criterion of 12ºC. Table 4.4-9 identifies the tributaries in which the 12ºC criterion applies. Temperature data were collected sporadically, so it is not possible to present data for the same year in all tributaries. However, all data are from recent years. The temperature measurement sites are located well upstream of Ross Lake (measurement location coordinates are provided in Table 4.4-9), so reported temperatures are representative of the streams, i.e., temperatures are not influenced by the Project.



Source: Connor 2019.

Figure 4.4-11. Thermal profile measurements made at Ross Lake during August 2016.

Table 4.4-9. Monthly average and maximum water temperatures (°C) in select tributaries to Ross Lake.

Month	Temperature (°C)		Number of Consecutive Days ≥ 12°C	Char Spawning/Rearing Criterion (12°C 7-DADMax) Exceeded
	Monthly Average	Monthly Maximum		
Skagit River at Swing Bridge (49.01879, -121.06074) (Connor 2019)				
Jun 2014	7.3	9.7	0	NA
Jul 2014	10.2	13.5	5	NA
Aug 2014	11.1	14.0	13	NA
Sep 2014	9.1	11.6	0	NA
Big Beaver Creek (48.77778, -121.07222) (Data from USGS Gage #12172000)				
Jul 2018	9.8	12.4	4	Yes
Aug 2018	10.0	12.4	2	No
Sep 2018	8.7	10.7	0	No
Lightning Creek (48.87557, -121.00912) (Connor 2019)				
Jun 2016	8.0	11.0	0	No
Jul 2016	9.1	11.4	0	No
Aug 2016	9.5	10.9	0	No
Sep 2016	8.6	9.7	0	No
Little Beaver Creek (48.89580, -121.25409) (Connor 2019)[1]				
Jun 2016	7.0	11.2	0	No
Jul 2016	7.9	11.7	0	No
Ruby Creek (48.70833, -120.97611) (Data from USGS Gage #12173500)				
Jun 2018	7.3	10.3	0	No
Jul 2018	11.7	13.5	10	Yes
Aug 2018	11.3	13.6	15	Yes
Sep 2018	9.2	11.2	0	No
Silver Creek (48.96782, -121.10489) (Connor 2019)				
Sep 2015	9.0	11.0	0	No
Jun 2016	7.7	11.0	0	No
Jul 2016	9.5	12.4	2	No
Aug 2016	10.7	12.3	7	Yes

1 Recorded temperatures indicate that the temperature logger in Little Beaver Creek was exposed to the air in August and September 2016, so recorded temperatures for these months are not included in the table.

Diablo Lake

The highest mean daily surface (at 5 feet depth) water temperature measured at the log boom site in Diablo Lake during 2017 was 16.4°C, and mean surface temperatures exceeded 16°C on only 2 days. This is similar to observations in 2014-2015 (Figure 4.4-10b). The maximum surface water temperature measured at the log boom site in Diablo Lake during 2017 was 17.6°C, and maximum surface temperatures exceeded 16°C on only 15 days (7-DADMax surface temperatures at times exceeded 16°C). However, at 15 feet, the maximum temperature exceeded 16°C on only one day, and maximum temperatures between 25 feet and 85 feet never exceeded 14.8°C.

Diablo Lake, with a detention time of 9.4 days, is considered a riverine waterbody when evaluating compliance. As shown in Table 4.4-7, the 16°C 7-DADMax criterion applies to this waterbody. Additionally, WAC 173-201A-200(1)(c)(vi) provides that temperature measurements should be taken to represent the "dominant aquatic habitat" of the monitoring site, which would not include the reservoir's surface. Based on the data, it appears that Diablo Lake temperatures are in compliance with the State's criterion. Temperatures in the "dominant aquatic habitat," i.e., the vast majority of the water column, provide suitable temperatures for salmonids throughout the year.

Gorge Lake

During 2017, maximum surface water temperature (at 10 feet depth) measured at the log boom site in Gorge Lake was 14.0°C, and maximum temperatures between 25 feet and 85 feet never exceeded 12.2°C. The highest daily mean surface (at 10 feet depth) water temperature measured at the log boom site in Gorge Lake during 2017 was 11.8°C, i.e., mean temperatures were slightly lower than they were in 2014-2015[14] (Figure 4.4-10c). However, profile data collection at the Gorge Lake log boom ceased on August 3, 2017, so data are unavailable for a portion of the time of year when water temperatures would be highest.

Gorge Lake, with a detention time of 0.8 days, is considered a riverine waterbody when evaluating temperature compliance, i.e., the 16°C 7-DADMax criterion applies to this waterbody. It is clear that Diablo Lake temperatures are in compliance with the State's criterion, i.e., existing data show that temperatures do not equal or exceed 16 °C at any time, and the majority of the water column is well below the criterion at all times of year.

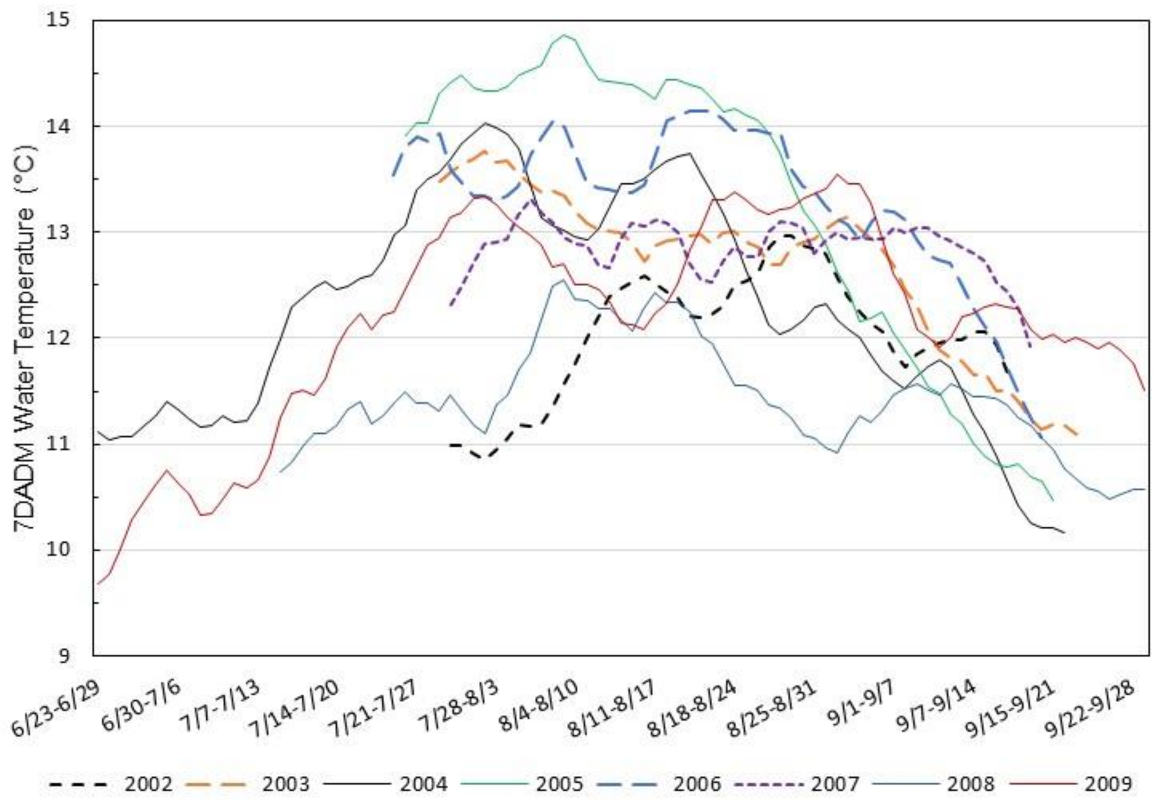
Gorge Bypass Reach

As described above, the water temperatures in the 2.5-mile bypass reach between Gorge Dam and Gorge Powerhouse are not to exceed 21ºC as a result of human activities. Temperature monitoring conducted by City Light showed that water temperatures in the bypass reach did not exceed 21ºC (Envirosphere 1988).

Skagit River Downstream of Gorge Powerhouse

Plots of continuously measured (by Ecology) 7-DADMax water temperatures in the Skagit River at Marblemount (≈RM 78) from June/July – September, 2002-2009 are shown in Figure 4.4-12 (see footnotes to Figure 4.4-12 for a delineation of each year's continuous measurement period). At no time during the period of measurement did the 7-DADMax temperatures exceed the relevant summer criterion for this waterbody: i.e., core summer salmonid habitat, 16°C (60.8°F) from June 15 – September 1 (Figure 4.4-12). Average monthly minimum, average, and maximum temperatures, based on continuous monitoring from 2002-2009, are shown in Table 4.4-10.

[14] Note that water temperatures in Gorge Lake were higher than usual during the latter half of August 2015 due to uncharacteristic Project operations (Figure 4.4-10c). The atypical warming occurred because City Light was required to shut down the Project from August 19–29, 2015 due to the Goodell Fire, which resulted in spill at all three reservoirs during this period, i.e., more surface water from Ross Lake was released than would have been under normal operations.



Source: Ecology 2019.

Figure 4.4-12. Continuously measured 7-DADMax water temperatures (°C) in the Skagit River at Marblemount (≈RM 78), June/July – September in years 2002-2009,[15] i.e., the data collection period common to all sampling years.

[15] Continuous temperature measurements at Marblemount (2002-2009) were made by Ecology during the following date ranges: (1) July 24 – September 17, 2002; (2) July 23 – September 23, 2003; (3) June 23 – September 22, 2004; (4) July 20 – September 21, 2005; (5) July 19 – September 20, 2006; (6) July 24– – September 19, 2007; (7) July 9 – September 29, 2008; and (8) June 23 – September 29, 2009.

Table 4.4-10. Monthly averages (±SD) of minimum, average, and maximum daily water temperatures (°C) measured continuously in the Skagit River at Marblemount, June/July – September in 2002-2009.

Month	2002	2003	2004	2005	2006	2007	2008	2009
Minimum Temperatures								
June	NA	NA	9.6 (0.3)	NA	NA	NA	NA	8.3 (0.2)
July	9.8 (0.2)	10.9 (0.3)	10.3 (0.6)	10.8 (0.4)	10.9 (0.4)	10.5 (0.2)	9.4 (0.5)	9.8 (0.9)
August	10.2 (0.5)	10.8 (0.3)	11.3 (0.3)	11.2 (0.4)	11.0 (0.3)	10.8 (0.2)	10.3 (0.4)	10.8 (0.3)
September	10.2 (0.3)	10.3 (0.3)	10.0 (0.5)	9.8 (0.4)	10.4 (0.3)	10.7 (0.3)	9.7 (0.2)	10.5 (0.5)
Average Temperatures								
June	NA	NA	10.3 (0.2)	NA	NA	NA	NA	9.0 (0.3)
July	10.4 (0.3)	12.1 (0.3)	11.2 (0.8)	12.4 (0.4)	12.0 (0.4)	11.3 (0.2)	10.2 (0.4)	10.6 (0.9)
August	11.0 (0.6)	11.8 (0.2)	12.0 (0.4)	12.5 (0.5)	12.3 (0.4)	11.7 (0.3)	11.0 (0.5)	11.7 (0.4)
September	10.9 (0.2)	10.9 (0.4)	10.5 (0.6)	10.4 (0.5)	11.2 (0.6)	11.5 (0.4)	10.2 (0.2)	11.2 (0.5)
Maximum Temperatures								
June	NA	NA	11.1 (0.3)	NA	NA	NA	NA	9.8 (0.5)
July	11.1 (0.6)	13.6 (0.4)	12.4 (1.1)	14.2 (0.6)	13.5 (0.7)	12.4 (0.5)	11.1 (0.6)	11.7 (1.2)
August	12.3 (0.7)	13.0 (0.4)	13.0 (0.8)	14.1 (0.8)	13.1 (0.7)	12.9 (0.7)	11.8 (0.7)	12.9 (0.7)
September	11.8 (0.6)	11.8 (0.8)	11.0 (0.7)	11.2 (0.8)	12.2 (1.0)	12.6 (0.7)	11.1 (0.5)	12.1 (0.7)

Source: Ecology 2019.
NA = no measurements made in month/year.

During September the supplemental spawning and incubation protection temperature criterion applies to the Skagit River downstream of the Gorge Powerhouse i.e., 7-DADMax water temperatures must be 13°C or less (see criteria in Figure 4.4-9). Figure 4.4-12 shows that 7-DADMax temperatures were ≤ 13°C during September of all years, except for early September 2006 (Table 4.4-11), when there were slight exceedances.

Table 4.4-11. Measured 7-DADMax water temperatures (°C) in the Skagit River at Marblemount, September 2002-2009 (see also Figure 4.4-12).

	September							
Date(s)	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
7-DADMax Temperature								
9/1-9/7	11.9	12.7	11.6	12.1	13.2	13.0	11.4	12.6
9/2-9/8	11.7	12.5	11.5	11.9	13.1	13.0	11.5	12.4
9/3-9/9	11.8	12.3	11.6	11.7	13.1	13.0	11.6	12.1
9/4-9/10	11.9	12.1	11.7	11.5	12.8	13.0	11.5	12.0
9/5-9/11	12.0	11.9	11.8	11.5	12.7	13.0	11.5	11.9
9/6-9/12	12.0	11.8	11.7	11.3	12.7	13.0	11.6	12.0
9/7-9/13	12.0	11.8	11.5	11.2	12.5	12.9	11.5	12.2
9/7-9/14	12.1	11.7	11.3	11.0	12.3	12.8	11.4	12.2
9/9-9/15	12.1	11.7	11.1	10.9	12.1	12.7	11.4	12.3
9/10-9/16	11.9	11.5	10.9	10.8	12.0	12.5	11.4	12.3

	September							
Date(s)	2002	2003	2004	2005	2006	2007	2008	2009
9/11-9/17	11.7	11.5	10.7	10.8	11.7	12.4	11.4	12.3
9/12-9/18	--	11.4	10.4	10.8	11.5	12.3	11.3	12.3
9/13-9/19	--	11.2	10.3	10.7	11.3	11.9	11.2	12.1
9/14-9/20	--	11.1	10.2	10.6	11.1	--	11.1	12.0
9/15-9/21	--	11.2	10.2	10.5	--	--	10.9	12.0
9/16-9/22	--	11.2	10.2	--	--	--	10.8	12.0
9/17-9/23	--	11.1	--	--	--	--	10.7	12.0
9/18-9/24	--	--	--	--	--	--	10.6	12.0
9/19-9/25	--	--	--	--	--	--	10.6	11.9
9/20-9/26	--	--	--	--	--	--	10.5	12.0
9/21-9/27	--	--	--	--	--	--	10.5	11.9
9/22-9/28	--	--	--	--	--	--	10.6	11.8
9/23-9/29	--	--	--	--	--	--	10.6	11.5

In addition to the data presented above (i.e., for 2002-2009), Ecology measured temperatures daily (i.e., not continuously) throughout the year at Marblemount from 2009-2018. Average monthly temperatures for this period are provided in Table 4.4-12. Table 4.4-12 also includes average and maximum (July – September) water temperatures recorded in the Skagit River at Newhalem, also for the period 2009-2018, so the two locations can be compared. Monthly average temperatures at the two sites are similar in many months, but notably cooler at Newhalem from June – August, and warmer at Newhalem in November. Temperatures recorded at Newhalem from June – October (2009-2018) complied with relevant Ecology criterion (criteria = 7-DADMax of 16°C from June 15 – September 1 and 7-DADMax of 13°C from September 1 – June 15). Although August 2015 maximum temperatures peaked at 15.4 °C, all other maximums in August during the 2009-2018 period were ≤ 12.2°C.

Table 4.4-12. Average monthly water temperatures (°C) in the Skagit River at Marblemount and Newhalem and maximum (June – October) water temperatures at Newhalem, 2009-2018.

	Water Temperature (°C)			
	Marblemount[1]	Newhalem		
Month	Monthly Average	Monthly Average	Highest Monthly Maximum	Year in which Highest Monthly Maximum Occurred
January	4.8	4.8	--	--
February	4.5	4.2	--	--
March	4.6	4.2	--	--
April	5.9	5.3	--	--
May	7.8	7.3	--	--
June	9.1	8.5	10.8	2015
July	10.8	9.8	11.9	2015
August	11.9	10.9	15.4	2015

Month	Water Temperature (°C)			
	Marblemount[1]	Newhalem		
	Monthly Average	Monthly Average	Highest Monthly Maximum	Year in which Highest Monthly Maximum Occurred
September	10.8	10.6	12.3	2017
October	9.7	10.0	11.2	2010
November	7.7	8.8	--	--
December	6.3	6.5	--	--

Sources: Marblemount = Ecology (2019); Newhalem = USGS gage #12178000.

1 No data were reported for November 2013; data from October – December 2018 have not yet been reviewed by Ecology (as of April 2019).

As described above, the water temperatures in the 2.5-mile bypass reach between Gorge Dam and Gorge Powerhouse are not to exceed 21ºC as a result of human activities. Temperature monitoring conducted by City Light showed that water temperatures in the bypass reach did not exceed 21ºC (Envirosphere 1988).

Dissolved Oxygen

Project Reservoirs

<u>Ross Lake</u>

Measurements made in 2009 indicate there is complete dissolved oxygen saturation in Ross Lake throughout the water column (City Light 2010, as cited in NMFS 2012). Dissolved oxygen samples were also taken at eight stations upstream of Ross Dam during fall 1973, at 10-meter (32.8 feet) depth intervals. The lowest surface water concentration was 9.0 mg/L, measured mid-lake near Devils Creek in July 1973 (City Light 1974, as cited in City Light 2011b). The lowest overall recorded concentration (6.7 mg/L) occurred 9 miles upstream of Ross Dam, in the hypolimnion at a depth of 55 meters (3 m off the bottom) on November 7, 1973 (City Light 1974, as cited in City Light 2011b). Dissolved oxygen concentrations increased, and the depth of the thermocline decreased steadily with the onset of cooler weather and the resulting mixing of reservoir strata. No waterbodies in the upper Skagit River basin (WRIA 4) are 303(d)-listed for dissolved oxygen.

NPS measured dissolved oxygen along depth profiles in Ross Lake during 2015 and 2016. Sampling was conducted at three locations in the reservoir: Pumpkin Mountain (48.7904, -121.0496), Skymo (48.8547, -121.0308), and Little Beaver (48.9274, -121.0625). Each of these sampling sites is marked by a buoy located near the deepest part of the reservoir at that location. Pumpkin Mountain is the deepest, southernmost station, and Little Beaver is the shallowest, northernmost station. During each year, NPS measured profiles from June through November. However, profiles are only shown for the warmer months (July – September[16]) in Figure 4.4-13, i.e., when water temperatures are highest and reservoir stratification most pronounced (i.e., when dissolved oxygen is likely to be at its lowest).

At the Little Beaver sampling site, dissolved oxygen concentrations ranged from 8.3–10.6 mg/L during July–September of the two sampling years (Figure 4.4-13). Ranges for the Skymo and

[16] The NPS did not collect profile data in August 2015.

Pumpkin Mountain sampling sites ranged from 7.6-10.7 mg/L and 9.0-10.8 mg/L, respectively (Figure 4.4-13). The value of 7.6 mg/L at the Skymo site is an outlier, i.e., all other measurements were ≥ 8.0 mg/L, and the overwhelming majority were > 9.0 mg/L. Not included in the figures (to prevent graphic portrayals from being difficult to interpret due to excessive overlap of values) are results of dissolved oxygen measurements made at the three sampling locations during June, October, and November of 2015-2016. Ranges for profile measurements made during June, October, and November are shown in Table 4.4-13.

As noted above, Ross Lake has a detention time of 189.4 days, so it is subject to the dissolved oxygen lake criteria identified in Table 4.4-7, i.e., human actions considered cumulatively may not decrease the dissolved oxygen concentration more than 0.2 mg/L below natural conditions. Additionally, WAC 173-201A-200(1)(c)(vi) provides that dissolved oxygen measurements should be taken to represent the “dominant aquatic habitat” of the monitoring site, which "typically" would not include locations just above the reservoir’s bottom, which are not indicative of overall conditions. Dissolved oxygen concentrations in Ross Lake are in compliance with the State’s criterion in the “dominant aquatic habitat,” i.e., the vast majority of the water column provides concentrations that are suitable to optimal for salmonids throughout the year, including the summer months. Lower dissolved oxygen concentrations that occur occasionally near the reservoir’s bottom are not due to any identifiable human-caused impacts.

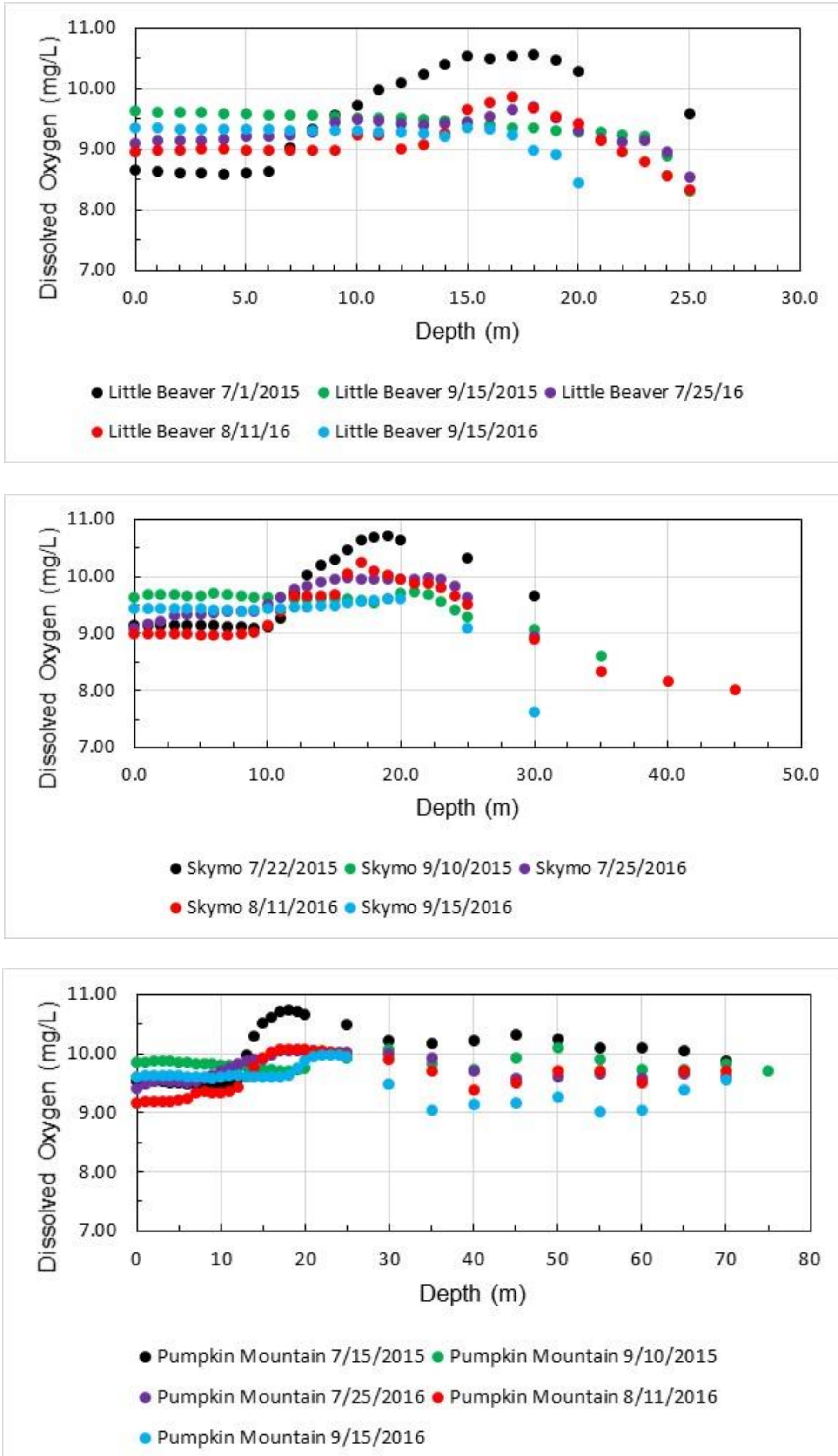


Figure 4.4-13. Dissolved oxygen (mg/L) profiles measured by NPS at three locations (Little Beaver, top plot; Skymo, middle plot; and Pumpkin Mountain, bottom plot) in Ross Lake in summer – early fall 2015-2016.

Table 4.4-13. Ranges of dissolved oxygen (mg/L) concentrations measured along vertical profiles at three locations (see text for description of locations) in Ross Lake (2015-2016).

Sampling Year	Dissolved Oxygen (mg/L)		
	June	October	November
Little Beaver			
2015	9.6–10.6	9.4–9.6	10.1–10.6
2016	9.8–10.3	9.1–9.2	9.9–10.0
Skymo			
2015	9.7–10.7	7.1[1]–9.7	9.9–10.1
2016	10.0–10.7	9.0–9.4	9.8–9.9
Pumpkin Mountain			
2015	9.5–10.8	8.6–9.6	8.5–9.7
2016	10.1–10.7	7.6–9.2	7.9–9.1

Sources: (Connor 2019).

1 All dissolved oxygen concentrations at this location were ≥ 8.1 mg/L, except for a single measurement of 7.1 mg/L at a depth of 35 feet.

Diablo Lake

Dissolved oxygen data were collected along vertical profiles in the Diablo Lake forebay during August 2017; concentrations were high throughout water column, ranging from 10.2 to 10.8 mg/l (Connor 2019).

Diablo Lake has a detention time of 9.4 days. Ecology’s criteria (WAC 173-201A-600) state that reservoirs with a mean detention time less than 15 days are considered riverine waterbodies when evaluating compliance, i.e., the relevant criterion stipulates that the lowest allowable 1-day minimum dissolved oxygen concentration is 9.5 mg/L. The dissolved oxygen measurements made in the warmest period of the year in 2017 show that dissolved oxygen concentrations are suitable for salmonids throughout the water column, and therefore in compliance with the State’s criterion. City Light plans to collect additional data to corroborate the 2017 findings.[17]

Gorge Lake

No dissolved oxygen data are available for Gorge Lake, although data collection is planned.[18] However, the reservoir has a detention time of 0.8 days and cool temperatures throughout the year. Dissolved oxygen concentrations in Gorge Lake almost certainly reflect those in Diablo Lake immediately upstream, and as a result are also in compliance with Ecology’s criterion.

Skagit River Downstream of Gorge Powerhouse

Results of monthly dissolved oxygen measurements in the Skagit River downstream of Gorge Powerhouse at Marblemount, 2009-2018 are presented in Table 4.4-14. All monthly averages are well above Ecology’s temperature criterion for the Skagit River in WRIA 4, i.e., dissolved oxygen must be ≥ 9.5 mg/L. The criterion specifically states that the lowest 1-day minimum cannot fall

[17] City Light plans to collect additional water quality data in Diablo Lake; see Section 5 of this PAD.
[18] City Light plans to collect water quality data in Gorge Lake; see Section 5 of this PAD.

below 9.5 mg/L; the lowest measured value in Ecology's dataset is 9.8 mg/L, measured on August 19, 2009. The next lowest value was 10.3 mg/L, measured on June 11, 2015.

Table 4.4-14. Results of monthly water quality measurements in the Skagit River at Marblemount, 2009-2018 (except alkalinity, which was only measured during 2014-2018). Results are presented as monthly averages ± 1 standard deviation.

Month	Dissolved Oxygen[1] (mg/L)	pH[2]	Turbidity[3] (NTU)	Ammonia[4] (mg/L)	Total Phosphorus[5] (mg/L)	Fecal Coliform[6] (no./100 mL)	Specific Conductivity[7] (at 25°C) (µmhos/cm)	Alkalinity[8] (Total as $CaCO_3$) (mg/L)
January	12.7 (±0.2)	7.4 (±0.1)	0.9 (±0.5)	0.01 (NA)	0.008 (±0.004)	1.0 (±0.0)	65 (±3.9)	26.6 (NA)
February	12.8 (±0.5)	7.4 (±0.2)	0.9 (±0.6)	0.01 (NA)	0.006 (±0.002)	1.3 (±0.7)	64 (±4.2)	22.2 (NA)
March	12.9 (±0.3)	7.5 (±0.2)	0.8 (±0.4)	0.01 (NA)	0.006 (±0.001)	1.4 (±1.3)	65 (±5.0)	28.8 NA)
April	12.5 (±0.3)	7.4 (±0.1)	0.8 (±0.4)	0.01 (NA)	0.005 (±0.001)	1.3 (±0.7)	59 (±7.7)	25.4 (NA)
May	12.1 (±0.5)	7.3 (±0.2)	1.4 (±0.6)	0.01 (NA)	0.005 (<0.001)	2.2 (±2.3)	44 (±7.2)	17.1 (NA)
June	11.7 (±0.6)	7.4 (±0.1)	2.2 (±1.1)	0.01 (NA)	0.008 (±0.004)	2.7 (±1.6)	43 (±4.4)	13.8 (NA)
July	11.2 (±0.3)	7.4 (±0.1)	1.6 (±1.0)	0.01 (NA)	0.006 (±0.002)	2.5 (±2.7)	44 (±3.9)	15.6 (NA)
August	10.9 (±0.6)	7.4 (±0.2)	1.1 (±0.4)	0.01 (NA)	0.006 (±0.002)	1.7 (±0.8)	48 (±3.1)	19.4 (NA)
September	11.2 (±0.3)	7.3 (±0.2)	2.0 (±1.4)	0.01 (<0.01)	0.008 (±0.003)	5.5 (±6.1)	48 (±8.5)	20.2 (NA)
October	11.3 (±0.3)	7.3 (±0.2)	2.6 (±2.1)	0.02 (±0.01)	0.015 (±0.017)	4.0 (±2.1)	50 (±8.2)	16.4 (±2.2)
November	11.9 (±0.4)	7.3 (±0.2)	6.5 (±7.8)	0.01 (<0.01)	0.015 (±0.012)	3.4 (±3.6)	41 (±5.1)	14.5 (±4.4)
December	12.1 (±0.3)	7.4 (±0.2)	11.0 (±20.4)	0.01 (<0.01)	0.022 (±0.037)	2.1 (±1.9)	53 (±10.1)	17.4 (NA)

Source: Ecology 2019.

1 No dissolved oxygen data were reported for November 2013 and July 2018; the result from February 14, 2017, i.e., 15.8 mg/L appeared to be an outlier and was not included when computing the average or standard deviation (SD).

2 No data were reported for November 2009.

3 No data were reported for December 2013; turbidity levels of 28, NTU, 60 NTU, and 25 NTU were recorded for December 11, 2014, December 9, 2015, and November 29, 2017, respectively; these levels coincided with a high-flow event.

4 NA = no SD was computed when all values reported for a given month were identical (i.e., 0.01); in the vast majority of cases ammonia results were labeled "Analyte was not detected at or above the reported result."

5 No data were reported for January 2012, May 2016, and October 2018; in the vast majority of cases ammonia results were labeled "Analyte was not detected at or above the reported result."

6 No data were reported for December 2009, February 2014, October 2014, December 2016, December 2017, and October 2018.

7 No data were reported for January 2014 and February 2015.

8 Data were only reported for October – December 2014, January – November 2015, October – December 2017, January – September 2018; NA = no SD was computed for months with only two measurements.

Note: Data from October – December 2018 have not yet been reviewed by Ecology (as of April 2019).

Note: µmhos/cm = micromhos per centimeter.

pH

Project Reservoirs

Ross Lake

NPS measured pH along depth profiles in Ross Lake during 2015 and 2016. Sampling was conducted at the three locations described in the previous section: i.e., Pumpkin Mountain, Skymo, and Little Beaver. Measured pH values shown in Table 4.4-15 are in compliance with Ecology's criterion, i.e., within the range of 6.5 to 8.5 pH units (except for the values of 6.3 in October 2016 and 9.0 in October 2015).

Table 4.4-15. Ranges of pH measured along vertical profiles at three locations (see text for description of locations) in Ross Lake in 2015-2016.

	pH					
Sampling Year	**June**	**July**	**August[1]**	**September**	**October**	**November**
Little Beaver						
2015	7.6–8.2	7.6–8.2	--	7.4–8.1	7.7–9.0	7.6–7.8
2016	7.6–8.0	7.4–7.9	7.4–8.3	7.5–8.0	7.3–7.4	7.5–7.6
Skymo						
2015	7.5–8.2	7.6–8.3	--	7.3–8.1	7.0–7.9	7.7
2016	7.6–8.0	7.4–8.0	7.3–8.3	7.3–8.1	7.1–7.3	7.4–7.6
Pumpkin Mountain						
2015	7.4–8.2	7.6–8.3	--	7.4–8.1	7.1–7.8	6.9–7.6
2016	7.0–7.4	7.0–7.8	7.6–8.3	7.2–8.0	6.3–7.2	6.8–7.1

Sources: Connor 2019.

1 No profile data were collected during August 2015.

Diablo and Gorge Lakes

There are no pH data available for Diablo and Gorge Lakes, but values are likely comparable to those in Ross Lake, i.e., the primary source of water for the two downstream reservoirs. Both Diablo Lake and Gorge Lake have very short detention times and so likely have little influence on pH.

Skagit River Downstream of Gorge Powerhouse

Results of monthly pH measurements in the Skagit River at Marblemount, 2009-2018 are presented in Table 4.4-14. Ecology's criterion for the Skagit River in WRIA 4 requires pH to be within 6.5 to 8.5 pH units with human caused variation of less than 0.2 units. The monthly values shown in Table 4.4-14 fall within the middle of the range specified by Ecology, and low variability around the pH values show that they are quite consistent within a given month and throughout the year. There is no evidence to indicate that pH is being altered at the measurement location due to anthropogenic causes.

Turbidity

Turbidity in the Project reservoirs is influenced by seasonal runoff of silt and glacial flour and rain-on-snow events from upstream tributaries and the surrounding terrain. Suspended sediments are carried through the reservoirs and into the Skagit River below Gorge Powerhouse.

Project Reservoirs

Measurements made at the south end of Ross Lake from March – December 1973 showed that maximum turbidity (Secchi depth: 3.3 m) occurred in late May (City Light 1974). From mid-July to December, Secchi depth readings varied from 7.5-11.7 meters. In 1972 the minimum water transparency (Secchi depth of 1.4 m) was recorded on June 30 (City Light 1974). Under normal operations, the Project reduces turbidity relative to what it would be in the Project's absence, particularly downstream of Gorge Powerhouse, and no waterbodies in the upper Skagit River basin (WRIA 4) are 303(d)-listed for turbidity. However, Corkindale Creek, Diobsud Creek, Damnation Creek, and the Jordan-Boulder WUA were identified as impaired due to fine sediment resulting from forest management (Skagit River System Cooperative [SRSC] and WDFW 2005, as cited in City Light 2011b). There are no turbidity data available for Diablo and Gorge lakes.

Skagit River Downstream of Gorge Powerhouse

Results of monthly turbidity measurements in the Skagit River at Marblemount, 2009-2018 are presented in Table 4.4-14. Ecology's criterion for the Skagit River in WRIA 4 requires that turbidity not exceed either a 5 NTU increase over background when the background is 50 NTU or less; or a 10 percent increase in turbidity when the background is more than 50 NTU.

Average monthly turbidity values measured by Ecology and reported in Table 4.4-14 are very low from January – October (for the period 2009-2018); values for November and December are slightly higher, which reflects a few isolated spikes in turbidity associated with high-flow events. Turbidity measurements of 28 NTU, 60 NTU, and 25 NTU were recorded for December 11, 2014, December 9, 2015, and November 29, 2017, respectively. The elevated levels of measured turbidity on these days were correlated with high flows, which occurred simultaneously with and in the days leading up to the measurement date. Maximum daily flows for the months during which elevated turbidity levels were observed are shown in Table 4.4-16. Precipitation totals for the town of Concrete are provided in Table 4.4-17 for the periods when elevated turbidity levels occurred at Marblemount (i.e., precipitation data for the four days prior to, the day of, and the four days after the turbidity event). Although the town of Concrete is located downstream of the Project, it is nearby (at the confluence of the Baker and Skagit rivers), so although precipitation totals likely differ from those experienced in and upstream of the Project vicinity, the general precipitation pattern should be similar. Precipitation data show that the high streamflows during episodes of elevated turbidity are correlated with large precipitation events.

Table 4.4-16. Maximum daily flows (cfs) measured at the USGS gage at Marblemount, WA (#12181000). Dates when elevated turbidity was measured in the Skagit River at Marblemount are shown in bold.

Date	Flows (cfs) in Dec 2014	Flows (cfs) in Dec 2015	Flows (cfs) in Nov 2017
1	15,600	6,150	4,120
2	16,400	6,650	4,320
3	9,090	7,260	4,400
4	5,960	7,980	4,460
5	6,730	7,390	4,330
6	7,310	8,280	4,330
7	6,910	9,230	4,260
8	7,240	14,700	4,560
9	17,300	**15,300**	4,870
10	15,700	11,400	4,940
11	**15,700**	9,980	4,780
12	15,200	9,120	4,870
13	14,000	8,820	5,660
14	13,400	7,710	5,710
15	13,100	7,540	5,810
16	11,200	7,320	5,570
17	6,570	7,050	5,230
18	5,980	7,150	5,170
19	6,180	6,930	5,170
20	6,040	6,990	5,820
21	7,780	6,990	8,380
22	7,010	6,470	26,000
23	7,210	6,960	34,400
24	7,550	6,790	12,700
25	6,860	6,460	8,560
26	6,540	6,630	11,000
27	6,380	6,630	10,600
28	6,280	6,500	13,000
29	5,950	6,290	**12,300**
30	5,810	6,530	13,100
31	5,750	6,360	--

Source: USGS 2019b.

Table 4.4-17. Precipitation (inches) measured at Concrete, Washington, December 2014 and 2015, and November 2017.

Dec 2014	Precipitation (inches)	Dec 2015	Precipitation (inches)	Nov 2017	Precipitation (inches)
12/7/14	0.16	12/5/15	0.38	11/25/17	0.11
12/8/14	Trace	12/6/15	1.81	11/26/17	0.83
12/9/14	1.20	12/7/15	0.61	11/27/17	1.10
12/10/15	0.80	12/8/15	0.73	11/28/17	0.13
12/11/14	0.68	12/9/15	1.77	11/29/17	0.67
12/12/14	0.72	12/10/15	0.31	11/30/17	0.10
12/13/14	0.47	12/11/15	0.37	12/1/17	0.47
12/14/14	0.00	12/12/15	0.04	12/2/17	0.69
12/15/14	0.00	12/13/15	0.80	12/3/17	0.40

Source: U.S. Climate Data 2019.

Fecal Coliform

Project Reservoirs

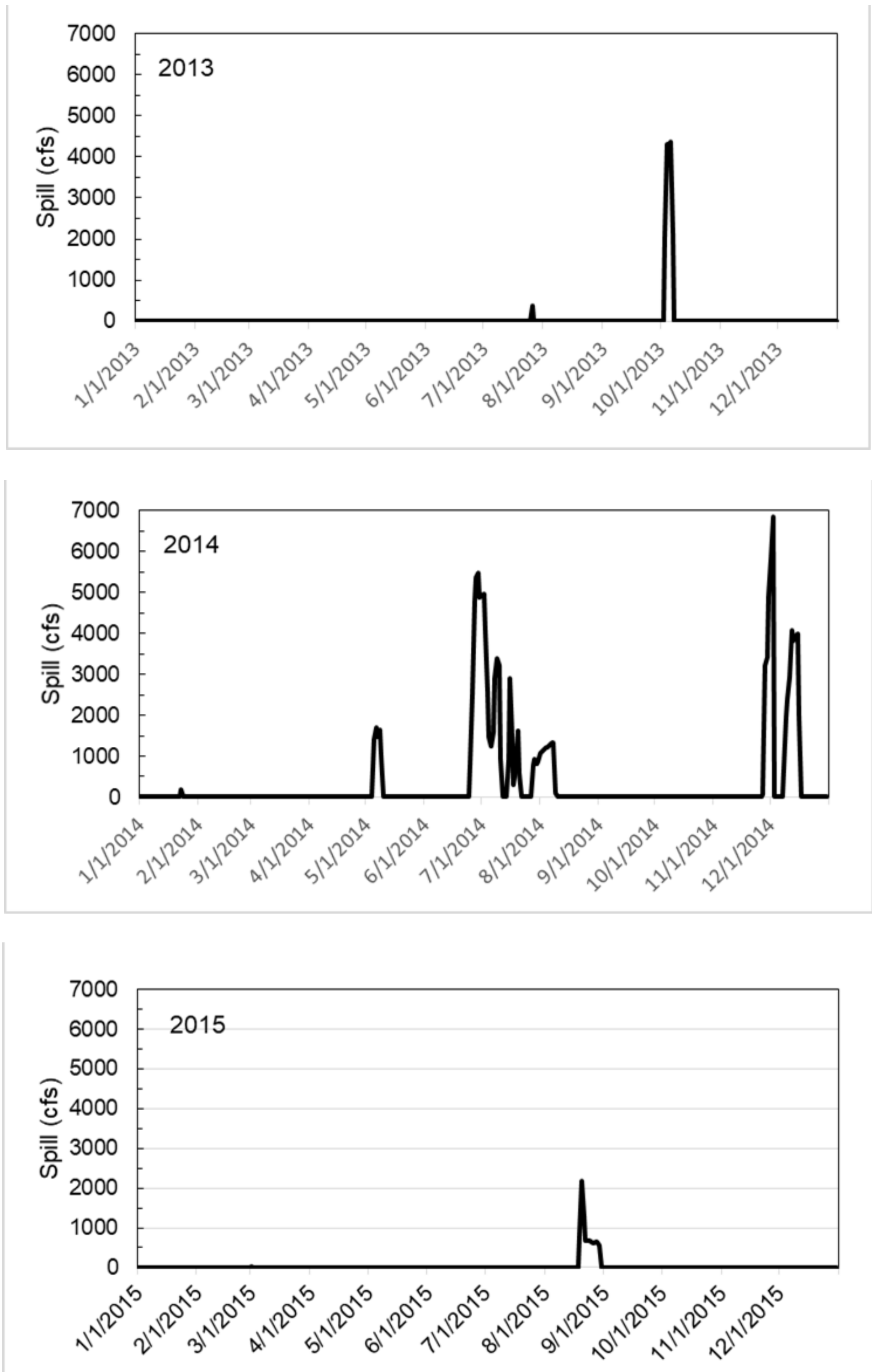
There are no fecal coliform data available for the Project reservoirs. However, there are limited sources of bacteria in the Project vicinity.

Skagit River Downstream of Gorge Powerhouse

Results of monthly fecal coliform measurements in the Skagit River at Marblemount, 2009-2018 are presented in Table 4.4-14. Ecology's criterion for the Skagit River in WRIA 4 requires that levels do not exceed a mean value of 50 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 100 colonies/100 mL. Values measured in the Skagit River at Marblemount during 2009-2018 are well below Ecology's criteria.

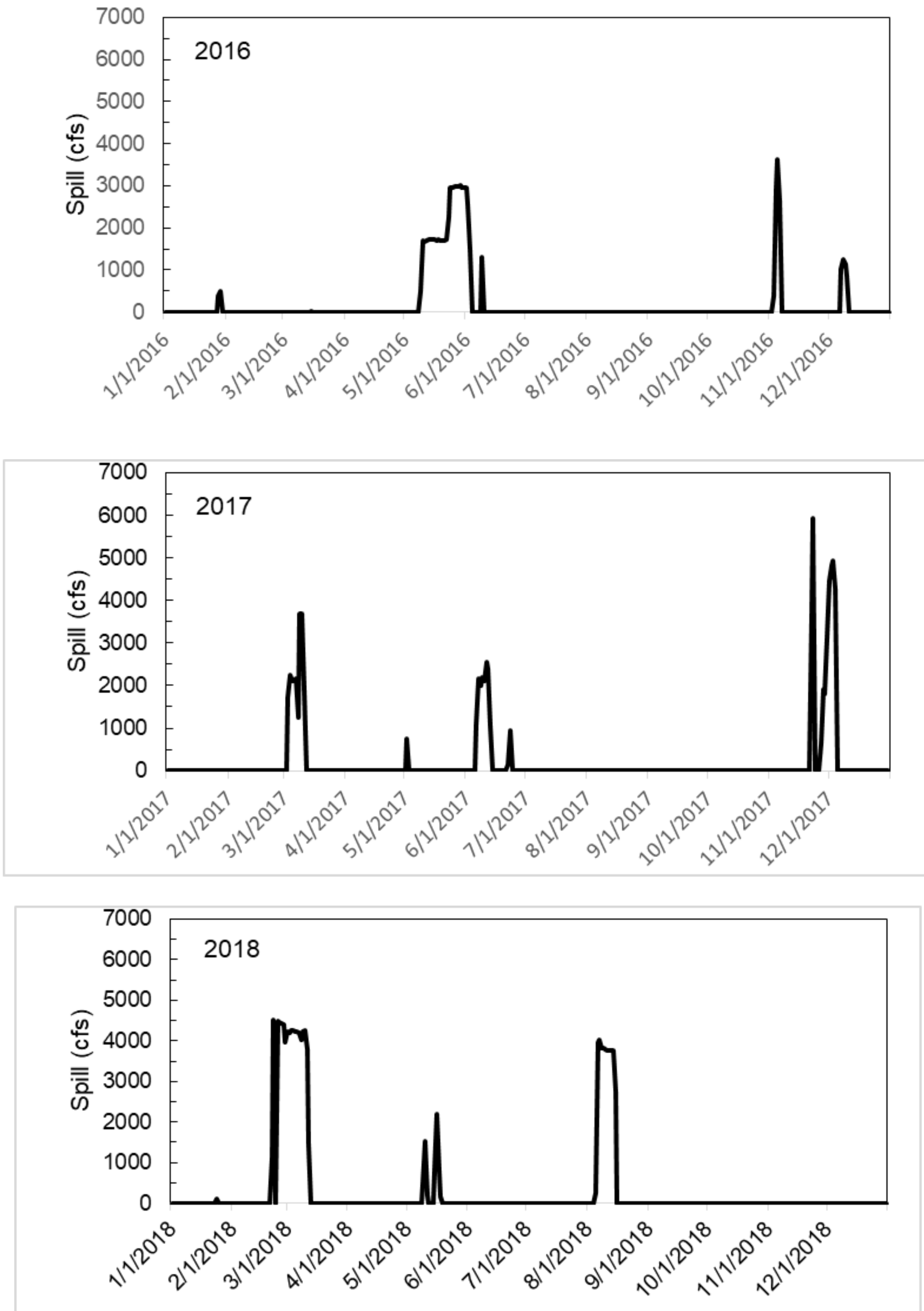
Total Dissolved Gas

Supersaturation of water with atmospheric gas, primarily nitrogen, can occur when water spills over high dams. TDG monitoring conducted in the Skagit River below the Project on July 10, 1997 confirmed that nitrogen saturation did not exceed the threshold criterion of 110 percent saturation (City Light 2011b). Five spill conditions were tested, and TDG measurements were taken in the Ross Dam forebay and downstream of Gorge Powerhouse. The highest measurement, 110.4 percent of saturation, was taken downstream of the Gorge Powerhouse. However, a lower reading of 107.4 percent of saturation was taken on the opposite bank from water flowing through the bypass reach, which diluted levels measured on the opposite bank. The three Project developments (Ross, Gorge, and Diablo) were not determined to have a cumulative effect on nitrogen saturation (Parametrix 1997). Even during spill events, the bypass reach is shallow and turbulent so that de-gassing occurs over the 2.5-mile reach (City Light 2011b). During many years, spill is relatively uncommon at the Gorge Development, although frequency and magnitude of spill vary among years in response to hydrologic conditions and maintenance work at the upstream developments. Figures 4.4-14a and 4.4-14b provide an example of spill releases at the Gorge Development, i.e., for the period 2013-2018.



Source: Connor 2019.

Figure 4.4-14a. Frequency and magnitude of spill at the Gorge Development (2013-2015).



Source: Connor 2019.

Figure 4.4-14b. Frequency and magnitude of spill at the Gorge Development (2016-2018).

Nutrients and Productivity

Project Reservoirs

NPS collected nutrient and productivity data in Ross Lake during 2015 and 2016 at the Pumpkin Mountain, Skymo, and Little Beaver sampling sites (site locations described previously). Measured concentrations of ammonia and phosphorus at all three locations were very low, indicating oligotrophic conditions. Chlorophyll *a* concentrations measured at the three locations are shown in Table 4.4-18. According to the Organization for Economic Co-Operation and Development (1982, as cited in Ecology 2004), chlorophyll-*a* concentrations < 2.5 micrograms per liter (µg/L) are indicative of oligotrophic lakes. The highest chlorophyll *a* concentration measured by NPS during the sampling period was 1.07 µg/L. There are no nutrient or productivity data available for Diablo and Gorge Lakes.

Table 4.4-18. Results of chlorophyll *a* sampling in Ross Lake (2015-2016).

		Chlorophyll *a* (µg/L)	
Sampling Site	**Sampling Date**	**Sample 1**	**Sample 2**
Pumpkin Mountain	5/14/2015	0.07	0.47
	6/16/2015	0.17	0.32
	7/15/2015	0.16	0.27
	8/18/2015	1.07	0.41
	9/10/2015	0.33	0.30
	10/14/2015	0.33	0.30
	11/16/2015	0.25	0.27
Skymo	6/16/2015	0.37	0.21
	7/15/2015	0.23	0.29
	8/18/2015	0.38	0.33
	9/10/2015	0.24	0.21
	10/14/2015	0.40	0.41
	11/16/2015	0.36	0.39
Little Beaver	6/16/2015	0.29	0.44
	7/15/2015	0.29	0.20
	8/18/2015	0.34	0.35
	9/10/2015	0.33	0.31
	10/14/2015	0.35	0.25
	11/16/2015	0.28	0.37

Source: Connor 2019.

Skagit River Downstream of Gorge Powerhouse

Results of monthly ammonia and total phosphorous measurements in the Skagit River at Marblemount, 2009–2018 are presented in Table 4.4-14. For the overwhelming majority of the measurements made by Ecology at Marblemount, the results were labeled "Analyte was not detected at or above the reported result." The low levels of nutrients reported are consistent with the oligotrophic conditions of upstream waterbodies, which in turn reflect the pristine condition of the watershed. There are no nutrient-related 303(d) listings for WRIA 4 (Table 4.4-8).

Other Chemical Parameters

Ross Lake Contaminants

Seiders and Deligeannis (2018) reported on contaminant concentrations in fish tissue collected in Ross Lake as part of Ecology's Freshwater Fish Contaminant Monitoring Program. The authors state that contaminant concentrations are low in fish from Ross Lake, with concentrations of metals in fish tissue similar to those found across Washington State.

Seiders and Deligeannis (2018) state that previous analyses of Bull and Rainbow trout tissue collected from Ross Lake (in 2007 and 2012) showed that PCBs, 4,4'-DDE, PBDEs, and PCDD/Fs were present at low levels, and concentrations of chromium, copper, selenium, and zinc were detected at levels typically seen in fish fillet tissues across Washington (Seiders and Deligeannis, 2009; Seiders et al., 2014, as cited in Seiders and Deligeannis 2018).

Seiders and Deligeannis (2018) reported that 2015 results show that contaminant concentrations in Ross Lake remained low. The 2015 results were derived from tissue taken from 70 Rainbow Trout and native char collected by NPS, which were analyzed for chlorinated pesticides, PCBs, PBDEs, and metals. Concentrations of chlorinated pesticides and PCBs were low "and comparable to levels seen in waterbodies deemed to have little apparent human impact (Johnson et al, 2010, 2013, as cited in Seiders and Deligeannis 2018)." Seiders and Deligeannis (2018) state:

> *"The concentrations of metals in the 2015 samples appear to be typical. Levels of copper were within or slightly above ranges (0.37-2.18 mg/kg, respectively) found in other studies in Washington (Energy, 2012; EPA). Concentrations of mercury in 2015 (0.147-0.600 mg/kg) seem typical for the size, age, and trophic level for the native char and rainbow trout that were analyzed. Levels of selenium were detected just above the reporting limit and were within a guideline of 3 mg/kg for the protection of piscivorous wildlife (MacDonald, 1994). Concentrations of zinc were also similar to the median value (8.2 mg/kg) for fish fillets across Washington as reported by Serdar and Johnson (2006)...The 2015 sample results should serve as a good baseline for future comparisons."*

As noted previously, the current EPA water quality assessment for WRIA 4 (Upper Skagit) also includes 2014 category listings for toxic substances[19] (based on fish tissue data) in Ross Lake. Ecology assigned a Category 1 (i.e., "water quality criteria are being met") value to all evaluated toxins; Ecology's website states "Fish tissue data from the most recent year showed that the [fish tissue equivalent concentration] FTEC was met; therefore the Assessment Unit [i.e., Ross Lake] meets the requirements for a Category 1 determination."[20]

[19] 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, Alpha-BHC, Beta-BHC, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, Hexachlorocyclohexane (Lindane), Toxaphene, Chlordane, 2,3,7,8-TCDD TEQ, 2,3,7,8-TCDD (Dioxin), Endosulfan, Aldrin.

[20] Per Ecology's website, "The FTEC is the concentration of a contaminant in fish tissue that Washington equates to the National Toxics Rule water quality criterion for the protection of human health."

Skagit River Downstream of Gorge Powerhouse

Ecology measured dissolved metals at Marblemount in 1994 and 1995 (Table 4.4-19). There are no metals-related 303(d) listings for WRIA 4 (Table 4.4-8). Levels of specific conductivity and alkalinity measured at Marblemount by Ecology are shown in Table 4.4-14.

Table 4.4-19. Dissolved (unless indicated as total recoverable) metals concentrations (µg/L) measured in water samples in the Skagit River at Marblemount (1994-1995) (i.e., the only years for which results are available).

Date	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
1994								
5/17	30[1,2]	0.04[2]	5.0[1,2]	0.36[3]	0.067[3]	0.001[2]	1.00[2]	**1.95[3]**
7/19	30[1,2]	0.04[2]	5.0[1,2]	0.23[3]	0.020[2]	0.001[2]	1.00[2]	1.00[2]
9/20	30[1,2]	0.04[2]	5.0[1,2]	0.22[3]	0.020[2]	0.001[2]	1.00[2]	1.00[2]
11/15	30[1,2]	0.04[2]	5.0[1,2]	0.25[3]	0.020[2]	0.001[2]	1.00[2]	1.00[2]
1995								
1/17	--	3.00[1,2]	--	12.00[1,3]	20.00[1,2]	--	--	5.90[1,3]
1/17	30[1,2]	0.02[2]	5.0[1,2]	0.21[3]	0.020[2]	0.003[3]	0.16[3]	0.40[2]
3/21	30[1,2]	0.03[2]	5.0[1,2]	0.24[3]	0.020[2]	0.001[2]	0.26[3]	0.40[2]

Source: Ecology 2019.
1 Total recoverable.
2 Analyte was not detected at or above the reported result.
3 Analyte was positively identified. The reported result is an estimate.

Ross Lake Zooplankton

In 2015 and 2016, zooplankton samples were collected by NPS in Ross Lake at Pumpkin Mountain, Skymo, and Little Beaver. As noted previously, Pumpkin Mountain is the deepest, southernmost station, and Little Beaver is the shallowest, northernmost station. The taxonomic composition of zooplankton collected at the three locations is shown in Table 4.4-20. The taxa assemblage is similar among sampling locations and months, and between years. A comparison of the number of species at the sampling sites during both years is shown in Figure 4.4-15. Taxa richness is similar between years, and there are no substantial differences among sampling locations, except for slightly lower numbers of taxa collected at the most downstream location (Pumpkin Mountain). However, in both years fewer species were collected during May and November than during the warmer months.

Zooplankton density (Figure 4.4-16) was more variable among years than taxa composition. Particularly, density was substantially higher in September and October of 2015 than the same months in 2016, especially at the most upstream sampling location (Little Beaver). The opposite was true during May, when density was notably higher at the Pumpkin Mountain station in 2016 than in 2015. Densities ranged from a low of 160 organisms/m^3 (0.16/L) to 8,294 organisms/m^3 (8.3/L) (most of the samples were along the low end of this range). The relatively low zooplankton densities measured in Ross Lake are consistent with its oligotrophic status. The Minnesota Department of Natural Resources (2014) reported an average zooplankton density of 4.6 organisms/L for the oligotrophic Trout Lake in northern Minnesota. Lockwood et al. (2001, as cited in City Light 2006) sampled zooplankton in Boundary Reservoir (which has a trophic status between oligotrophic and mesotrophic) in 2000; average zooplankton density based on these samples was 5.0 organisms/L.

Table 4.4-20. Zooplankton taxa composition in Ross Lake at Pumpkin Mountain (PM), Skymo (S), and Little Beaver (LB) (2015-2016).

Species	May	Jun			Jul			Aug			Sep			Oct			Nov		
	PM	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB
2015																			
Arcellinida																			
Difflugia sp.				--[1]	--	--		x	x		x	x				x	x		
Calanoida																			
Diaptomus (A.) *leptopus*	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Diaptomus (L.) *tyrrelli*	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Copepodid spp.	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Copepodid, small sp.	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Cladocera																			
Alona costata									x		x		x		x	x			
Bosmina longirostris	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Chydorus sphaericus							x	x	x	x	x	x	x	x	x			x	x
Diaphanosoma brachyurum												x							
Daphnia pulicaria	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Daphnia rosea	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Daphnia thorata		x	x	--	--	--	x		x	x	x	x	x	x	x	x	x	x	x
Holopedium gibberum	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Leptodora kindti	x	x	x	--	--	--	x	x	x										
Polyphemus pediculus	x	x	x	--	--	--	x	x	x	x		x	x		x	x			
Scapholeberis armata								x	x				x			x			
Cyclodoida																			
Diacyclops thomasi		x	x	--	--	--		x	x	x			x	x				x	
Microcyclops varicans	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x		x	x
Copepodid spp.	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Calanoida/Cyclopoida																			
Copepod nauplii	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Rotifera																			
Asplanchna priodonta	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x

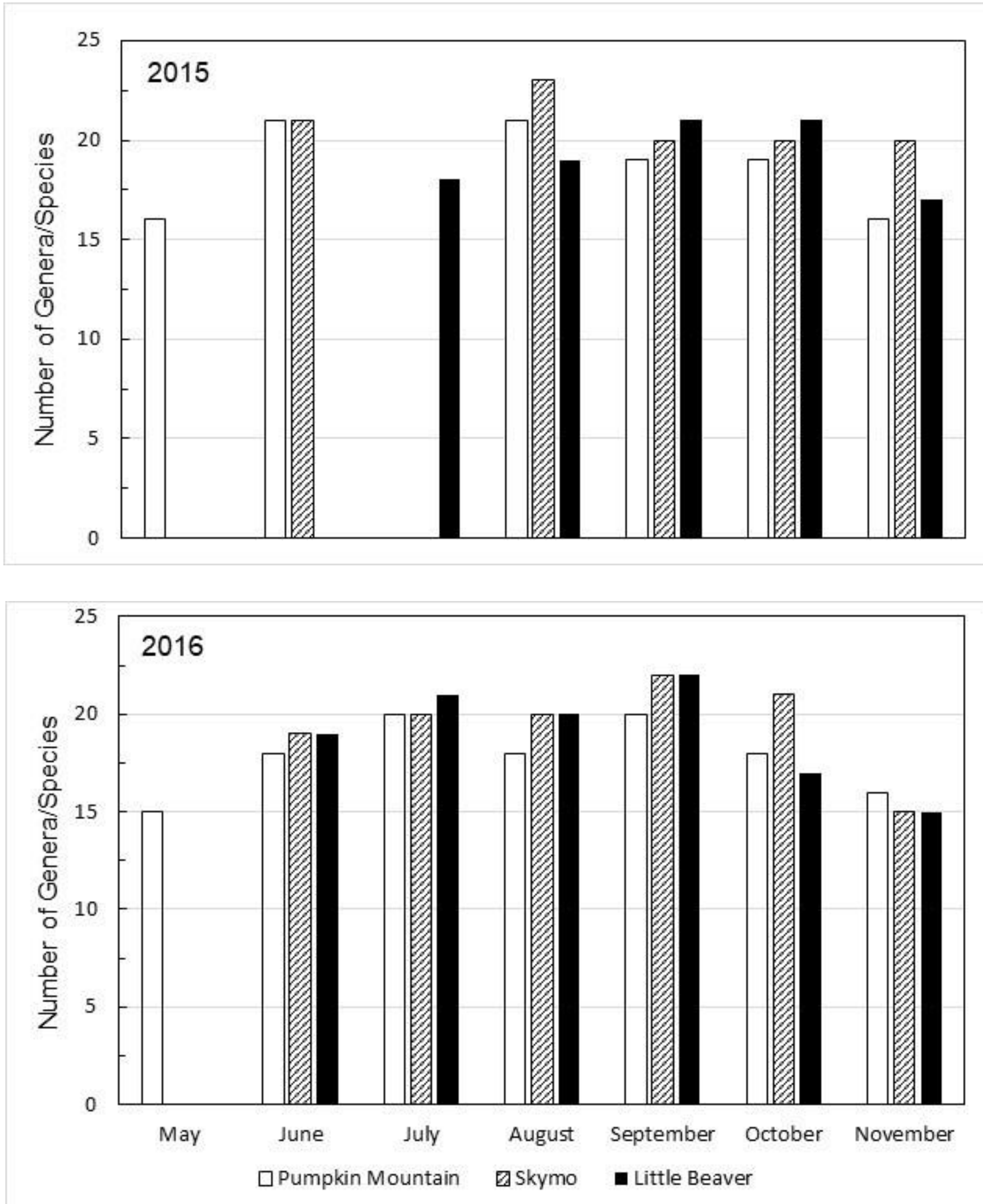
Species	May	Jun			Jul			Aug			Sep			Oct			Nov		
	PM	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB
Collotheca pelagica	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Conochilus unicornis	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Filinia terminalis		x		--	--	--													
Gastropus stylifer		x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Kellicottia longispina	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Keratella cochlearis var. *cochlearis*	x			--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Keratella cochlearis v. *tecta*																		x	
Ploesoma hudsoni		x	x	--	--	--								x	x	x		x	
Ploesoma truncatum		x	x	--	--	--													
Polyarthra vulgaris	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Synchaeta sp.	x	x	x	--	--	--	x	x	x	x	x	x	x	x	x	x	x	x	x
Trichotria tetractis			x	--	--	--													
Insecta																			
Chironomidae larvae	x		x	--	--	--					x							x	
Total Identified Genera/Species	16	21	21	--	--	--	18	21	23	19	19	20	21	19	20	21	16	20	17
2016																			
Arcellinida																			
Difflugia sp.					x														
Calanoida																			
Diaptomus (A.) *leptopus*	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x
Diaptomus (L.) *tyrrelli*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Copepodid spp.	x	x	x	x	x	x		x			x	x	x	x	x	x	x	x	x
Copepodid, small sp.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Epischurid copepodites												x	x	x				x	x
Cladocera																			
Alona costata												x			x				
Bosmina longirostris	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Chydorus sphaericus					x	x			x	x		x	x		x	x			
Diaphanosoma brachyurum													x						

Species	May	Jun			Jul			Aug			Sep			Oct			Nov		
	PM	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB	PM	S	LB
Daphnia pulicaria	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Daphnia rosea	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Daphnia thorata			x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Holopedium gibberum	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Leptodora kindti	x	x	x	x		x	x	x	x	x		x	x	x	x	x	x	x	
Macrothrix sp.													x						
Pleuroxus sp.		x								x									
Polyphemus pediculus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			
Scapholeberis armata					x	x	x	x	x		x								
Cyclodoida																			
Diacyclops thomasi				x	x	x	x	x	x	x	x	x	x						
Microcyclops varicans			x	x	x	x	x	x	x	x	x	x	x				x	x	
Copepodid spp.		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Calanoida/Cyclopoida																			
Copepod nauplii	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Rotifera																			
Asplanchna priodonta	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Brachionus urceolaris			x	x															
Collotheca pelagica		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Conochilus unicornis	x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x
Filinia terminalis							x												
Gastropus stylifer	x				x	x	x	x	x	x	x	x							
Kellicottia longispina	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Keratella cochlearis var. *cochlearis*		x					x		x	x	x	x	x	x	x	x	x	x	x
Keratella robusta	x	x	x	x															
Monostyla lunaris							x												
Ploesoma hudsoni														x	x				x
Ploesoma truncatum		x	x	x										x					
Polyarthra vulgaris	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Species	**May**	**Jun**			**Jul**			**Aug**			**Sep**			**Oct**			**Nov**		
	PM	**PM**	**S**	**LB**	**PM**	**S**	**LB**	**PM**	**S**	**LB**	**PM**	**S**	**LB**	**PM**	**S**	**LB**	**PM**	**S**	**LB**
Pompholyx sulcata											x	x	x		x				
Synchaeta sp.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Testudinella patina															x				
Insecta																			
Chironomidae larvae		x	x		x		x			x								x	
Nematoda																			
Nematode		x		x	x	x	x	x	x	x	x	x	x	x	x	x			
Total Identified Genera/Species	15	18	19	19	20	20	21	18	20	20	20	22	22	18	21	17	16	15	15

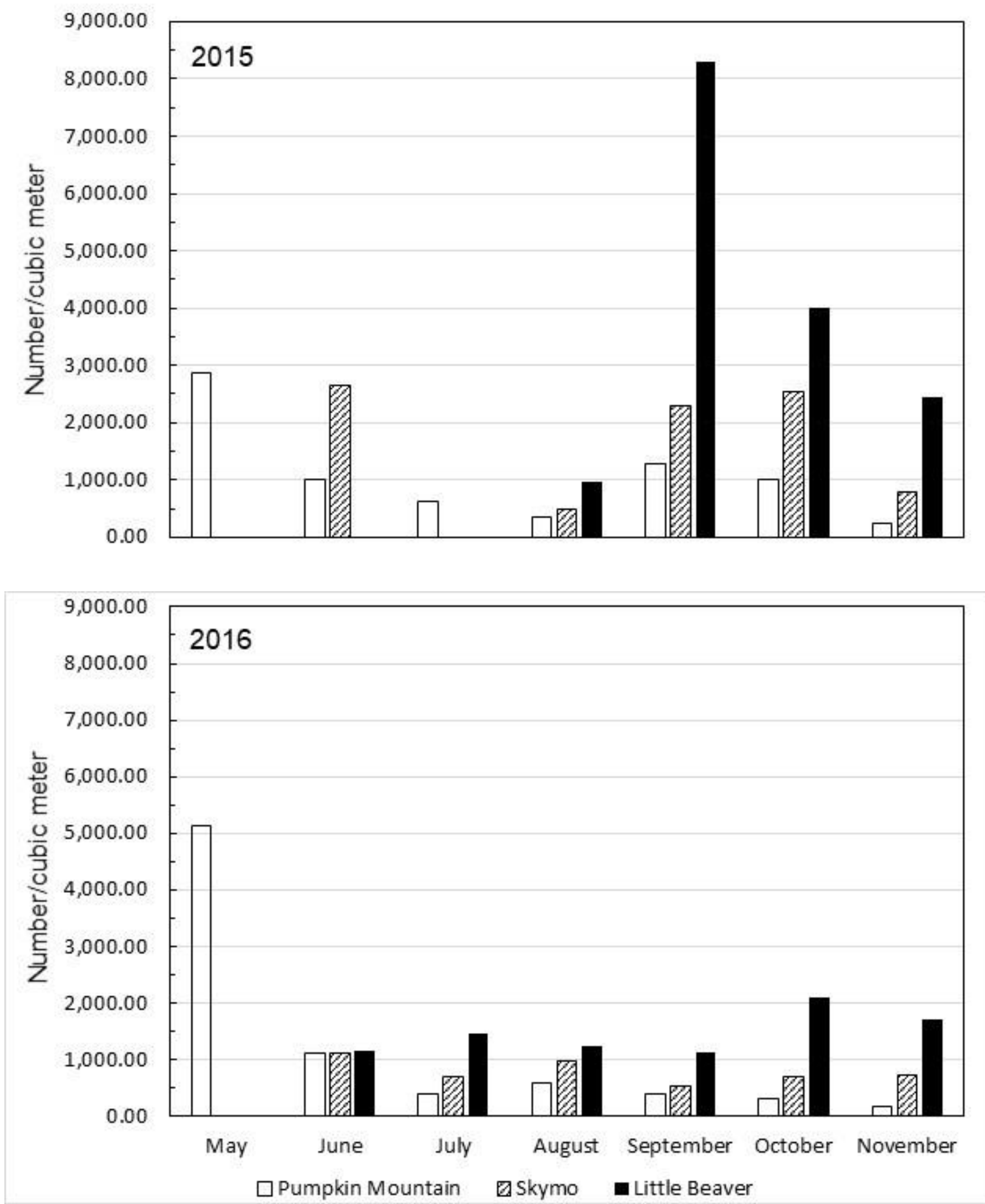
Source: Connor 2019.

1 "—" indicates that the location was not sampled during a given month/year.



Source: Connor 2019.

Figure 4.4-15. The number of zooplankton genera/species collected at three locations in Ross Lake from May – November 2015 (top) and 2016 (bottom). A missing bar indicates that no data were collected at a site during a given month.



Source: Connor 2019.

Figure 4.4-16. Zooplankton density in samples collected at three locations in Ross Lake from May – November 2015 (top) and 2016 (bottom). A missing bar indicates that no data were collected at a site during a given month.

Riverine Benthic Macroinvertebrates

Ecology collected BMI samples in six Skagit River basin tributary streams in WRIA 4: Bacon, Diobsud, Finney, Illabot, Jackman, and Pressentin creeks (Table 4.4-21; City Light 2011b). River Invertebrate Prediction and Classification System (RIVPACS) scores were computed for these samples. A RIVPACS score of 1.0 indicates that all expected taxa are present, whereas a score of less than 0.86 is considered to represent a degraded condition. Variability among years in the RIVPACS scores for Diobsud Creek show that caution is warranted when interpreting index values, because a small sample size, as expected, has the potential to result in erroneous conclusions. Conditions in these streams that influence BMI diversity and abundance are not affected by the Project.

Table 4.4-21. Benthic macroinvertebrate sampling in Skagit River tributaries.

Sample Location	Year Sampled	Number of Samples	RIVPACS Score
Bacon Creek	2000	4	0.98
Diobsud Creek	2004	4	0.72
	2003	4	NA
	2002	4	NA
	2000	4	0.93
	1995	4	0.81
Finney Creek	1995	4	0.56
Illabot Creek	1995	1	0.56
Jackman Creek	1995	1	0.56
Pressentin Creek	1998	4	0.81

Source: Ecology unpublished data, as cited in City Light 2011b.

In 2013, NPS field crews collected BMI samples in Stetattle Creek (a tributary to Gorge Lake) and its alluvial fan (Anthony and Rawhouser 2014). Samples in Stetattle Creek were selected randomly to characterize the lower stream reach, and sample locations on the alluvial fan were selected to characterize different types of habitat occurring on the fan. Table 4.4-22 is excerpted from Anthony and Rawhouser (2014; Table 9 from NPS report).

Table 4.4-22. Benthic invertebrate metric values for the samples collected in Stetattle Creek and the reference condition threshold for each metric established for streams in the North Cascades.

Metric	Reference Threshold	Stetattle Creek 1	Stetattle Creek 2	Stetattle Creek 3	Alluvial Fan 1	Alluvial Fan 2	Alluvial Fan 3
Abundance	N/A	608	837	678	344	280	611
Richness							
Total Richness	43	39	51	39	22	25	45
EPT[1] Richness	33	26	33	26	12	20	27
Community Composition							
% Ephemeroptera	87	51	60	71	38	33	55
% Plecoptera	28	11	11	6	5	35	13
% Trichoptera	26	3	4	3	12	12	5

Metric	Reference Threshold	Stetattle Creek 1	Stetattle Creek 2	Stetattle Creek 3	Alluvial Fan 1	Alluvial Fan 2	Alluvial Fan 3
EPT/Chironomidae (log10)	2.4	0.6	0.8	0.8	0.7	1.4	0.7
Feeding Guild							
% Scraper	60	21	26	25	8	26	32
% Shredder	16	5	2	1	16	42	14
Collector Richness*	5	9	16	13	11	6	14
Life History							
% Univoltine*[2]	46	54	53	42	84	88	63
Tolerance							
Hilsenhoff Biotic Index*	0.9	3.3	3.1	3.5	2.8	2.6	3.8
% Tolerant Taxa*	0	0	0.3	0.4	0.4	0	1.3
% Highly Intolerant Taxa	78	12	14	22	0.4	2	2
Intolerant Taxa Richness	13	13	15	13	5	11	14
% Cold and Cool Water Adapted	N/A	16	14	13	50	68	46

Source: Anthony and Rawhouser 2014.
* Metric response increases with increasing stress. All other metrics decrease in value with increasing levels of stress.
1 EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies).
2 Univoltine = a species that has one brood of offspring per year.

Anthony and Rawhouser (2014) concluded that (1) the BMI metrics reported in Table 4.4-22 indicate that the lower reach of Stetattle Creek at the time of sampling was not functioning at its full ecological potential when compared to reference streams; (2) it was not possible to assess the ecological function of the alluvial fan based on the samples collected, because reference values have not been established for the alluvial fan habitat type; and (3) the metrics indicate that water temperatures in the habitats of the alluvial fan were lower than those in Stetattle Creek.

Groundwater Quality

Groundwater samples collected on May 10, 2013 at the five piezometers in Diablo showed that nitrate was not detected at or above the laboratory reporting limit (i.e., well below Ecology's criterion of 10 mg/L[21]), and fecal coliform was not detected at or above the laboratory reporting limit. Results of water quality analysis for samples measured during well stabilization are shown in Table 4.4-23 (Hart Crowser 2013).

[21] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-200-040

Table 4.4-23. Water quality results for water samples collected from five piezometers near the Town of Diablo on May 10, 2013.

	Piezometer Number				
Parameter	**1**	**2**	**3**	**4**	**5**
Nitrate-N (mg/L)	0.10 U[1]	0.10 U	0.10 U	0.10 U	0.10 U
Total coliform (MPN/100 ml)[2]	2.0	1.8 U	13.0	17.0	1.8 U
Fecal coliform (MPN/100 ml)	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U
pH	6.6	6.6	6.3	6.1	6.3
Temperature (°C)	5.9	6.9	6.4	9.5	7.4
Dissolved oxygen (mg/L)	11.3	11.3	10.4	8.7	11.1
Turbidity (NTU)	33	7	30	40	1

Source: Hart Crowser 2013.
1 U = not detected at reporting limit indicated.
2 MPN per 100 mL.

4.4.6 Known or Potential Effects

4.4.6.1 Project-Related Effects

The Project has minimal effects on water quality in the upper Skagit River, as shown by the data reported in this section. The river drains mountainous, and in some cases glacial, areas located mainly within national park and wilderness areas, and water flowing through the Project remains clean and cold throughout the year. The few 303(d) listings for WRIA 4, which includes the Project, are for reaches not affected by the Project, reflecting the good baseline water quality measured in and downstream of the Project. Moreover, water quality data collected by Ecology confirm the high quality of water in the Skagit River downstream of the Project (measured at Marblemount and discussed in Section 4.4.5 of this PAD).

As described in Section 4.4.5, water quality in the Project reservoirs is good: cool water is available throughout the year for fish and other aquatic biota, dissolved oxygen levels are high, pH is within ranges suitable to aquatic biota, no other parameters indicate water quality issues, and none of the reservoirs is listed on Ecology’s 303(d) list of impaired waterbodies.

Project flow releases to the Skagit River and reservoir operations are described in sections 3.5.1 and 3.5.2 of this PAD, respectively, and the statuses of fish populations and aquatic habitat are addressed in Section 4.5. Although the Project alters the natural flow regime, water quantity is adequate at all times of year to support target organisms in the reservoirs and downstream of the Project. With no anticipated new consumptive uses of surface or groundwater during the next license term, no effects related to water rights are anticipated from the Project.

4.4.6.2 Cumulative Effects

Because the Project has minimal effects on water quality, the Project does not contribute to adverse cumulative effects on water quality in and downstream of the Skagit River. The Project does alter the flow regime of the basin. However, flow-related PME measures have been designed to support anadromous and resident salmonids at all times of year downstream of the Project (see Section 4.5 of this PAD for an assessment of Project effects on fish and aquatic resources).

Most climate models predict that warmer air temperatures will occur in Washington in the future, along with increases in winter precipitation and decreases in summer precipitation. Warmer air temperatures will lead to higher water temperatures and more precipitation falling in the form of rain as opposed to snow. With a reduced snowpack there will likely be a shift in the streamflow regime, which may include an increase in peak flows. However, Ross Lake stores a large volume of cold water, which may contribute positively to cumulative effects in the Skagit River basin in the future.

4.4.7 Existing or Proposed Protection, Mitigation, and Enhancement Measures

Because water quality in the Project vicinity is good, and because the Project and its operation do not result in adverse effects on water quality, City Light does not currently implement water quality related PME measures, nor are any water quality related PME measures proposed for the new license term. Existing flow-related PME measures have been formulated for the protection and benefit of fish and aquatic resources, salmonids in particular, as described in Section 4.5 of this PAD.

4.5 Fish and Aquatic Resources

This section describes the fish and aquatic habitat currently found within the Project Boundary and the broader Project vicinity, which extends downstream from Newhalem to the Sauk River confluence. The geographic scope of this section encompasses the Project reservoirs (Ross, Diablo, and Gorge lakes) and their tributaries, the bypass reach, and the Skagit River and its major tributaries between the Gorge Development and the Sauk River confluence (Figure 3.2-1). This section further describes the rare, threatened, and endangered (RTE) fish species that can be found within the Project vicinity and their federally-designated critical habitat. It also describes essential fish habitat (EFH)[22] conditions for those salmonid species that can be found within the Project vicinity for which there is an approved federal fisheries management plan (FMP) developed according to the 2007 Magnuson-Stevens Fishery Conservation and Management and Reauthorization Act (MSA). Particular focus is given in this section to summarizing the known and potential effects of the Project on these aquatic resources, and the existing and proposed PME measures to address these effects. Discussion of wetland, riparian, and littoral habitats primarily occurs in Section 4.6.1 of this PAD. However, some aspects of these habitats that are interrelated with fish and aquatic resources, such as LWD derived from riparian areas, are discussed in this section.

4.5.1 Existing Fish and Aquatic Communities

The Skagit River downstream of the Gorge Powerhouse provides important spawning and rearing habitat for eight anadromous fish species including Chinook (*Oncorhynchus tshawytscha*), Coho (*O. kisutch*), Pink (*O. gorbuscha*), and Chum (*O. keta*) salmon; steelhead (*O. mykiss*), Coastal

[22] Section 3(10) of the MSA defines EFH as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The MSA provides the following additional definitions for clarification: waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include historical areas if 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.

Cutthroat Trout (*O. clarki*), Bull Trout (*Salvelinus confluentus*), and Pacific Lamprey (*Entosphenus tridentatus*) (Table 4.5-1). Native Chinook Salmon, steelhead, and Bull Trout that utilize the Project Vicinity are listed as threatened under the ESA. White Sturgeon (*Acipenser transmontanus*) can also be found holding in deep pools in the lower Skagit River (near Mount Vernon). However, there is no verifiable evidence documenting White Sturgeon use of the upper Skagit River within the Project vicinity.

Resident fish species in the Project vicinity, including in Ross, Diablo, and Gorge lakes, include Bull Trout, Dolly Varden (*Salvelinus malma*), Cutthroat Trout, Rainbow Trout (*O. mykiss*), Brook Trout (*Salvelinus fontinalis*), Redside Shiner (*Richardsonius balteatus*), Mountain Whitefish (*Prosopium williamsoni*), sculpin (*Cottis* spp.), Salish Sucker (*Catostomus* sp.), Largescale Sucker (*Catostomus macrocheilus*), Lamprey (*Lampetra* spp.), Longnose Dace (*Rhinichthys cataractae*), and Threespine Stickleback (*Gasterostreus aculeatus*). Only Bull Trout, Dolly Varden, Rainbow Trout, Cutthroat Trout, Brook Trout, and Redside Shiner are found above Gorge Dam. These six species are found within all three Project reservoirs and some of the reservoirs' tributaries.

Under existing conditions, the Skagit River basin supports the largest run of Chinook Salmon in the Puget Sound region, one of the largest runs of Pink Salmon in the coterminous United States, and regionally large runs of Coho Salmon (Connor and Pflug 2004). The Skagit River system also supports two of the largest and most diverse Bull Trout Core populations in the Coastal Recovery Unit, which includes western Oregon and Washington (USFWS 2013). Although Chum Salmon were once abundant in the lower Skagit River and its tributaries, their numbers have declined substantially in the last few decades (Cauvel 2019).

Three treaty tribes (the Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, and Upper Skagit Indian Tribe) currently operate commercial, ceremonial, and subsistence salmon and steelhead fisheries in the Skagit River, and there are substantial recreational fisheries for Chinook, Coho, odd-year Pink Salmon, Bull Trout, and winter steelhead distributed from the mouth up the mainstem and into the major tributary systems of the Cascade and Sauk rivers (NMFS 2014). The Marblemount and Baker Lake hatcheries, the only hatcheries currently operating within the Skagit River basin, produce summer and spring Chinook, Coho, and Sockeye Salmon to augment the natural production of these species[23] (NMFS 2015). Fisheries for Sockeye and Coho Salmon in this area are primarily supported by a combination of hatchery and natural-origin populations. The spring Chinook fishery is a targeted harvest on a hatchery stock. The summer Chinook hatchery program is relatively small in scale and is operated as an indicator stock program[24] (NMFS 2014).

The following sections describe the general life history, distribution, abundance, and demographics (where information is available) for each of these species/populations. Table 4.5-1 summarizes their current status and distribution in the Skagit River upstream of the Sauk River confluence. A review of their key life history and habitat requirements is presented in Table 4.5-2 and Figure 4.5-1. Information about RTE fish species (description of listed unit, population status, limiting factors, and recovery planning) and designated critical habitat in the Skagit River basin is

[23] Chinook and Coho Salmon are produced at the Marblemount Hatchery, and Sockeye Salmon are produced at the Baker Lake Hatchery. The Marblemount Hatchery winter steelhead program ended in 2016 and the Barnaby Slough winter steelhead program ended in 2009 (NMFS 2015).
[24] Indicator stocks are used to model the effects of mixed stock fisheries on wild salmon populations.

presented in sections 4.5.3 and 4.5.4, respectively. BMI and zooplankton that reside in these waterbodies are discussed in Section 4.4 of this PAD.

Table 4.5-1. Fish species status, relative abundance, and distribution in the Skagit River upstream of the Sauk River confluence.

Species	Status[1]	Presence/Absence in the Skagit River Upstream of the Sauk River Confluence[2]				
		Ross Lake	Diablo Lake	Gorge Lake	Gorge Bypass Reach	Skagit R. (upstream of Sauk R.)
Chinook Salmon	Native, ESA Listed - Threatened	N	N	N	P	P
Coho Salmon	Native	N	N	N	P	P
Pink Salmon	Native	N	N	N	P	P
Chum Salmon	Native	N	N	N	P	P
Sockeye Salmon	Native	N	N	N	N	P
Steelhead (anadromous *O. mykiss*)	Native, ESA Listed - Threatened	N	N	N	P	P
Bull Trout	Native, ESA Listed - Threatened	P	P	P	N	P
Dolly Varden	Native	P	P	P	N	N
Cutthroat Trout	Non-native upstream of Gorge Dam, Native downstream	P	N	N	N	P
Rainbow Trout (resident *O. mykiss*)	Native	P	P	P	P	P
Brook Trout	Non-native	P	P	P	P	N
White Sturgeon	Native	N	N	N	N	N
Pacific Lamprey	Native	N	N	N	N	P
Redside Shiner	Non-native upstream of Gorge Dam, Native downstream	P	P	P	N	N
Mountain Whitefish	Native	N	N	N	N	P
Longnose Dace	Native	N	N	N	N	P
Salish Sucker	Native	N	N	N	N	P
Largescale Sucker	Native	N	N	N	N	P
Threespine Stickleback	Native	N	N	N	N	P
Sculpin spp.	Native	N	N	N	P	P

Source: Lowery 2019.

1 Native fish are those species that are indigenous to the local area. Nonnative fish may be present as the result of either deliberate or accidental introductions by humans.

2 Codes: P=present, N=not recorded in past or present studies (likely absent or very rare).

Table 4.5-2. Key life history and habitat requirements of fish species in the Project vicinity.

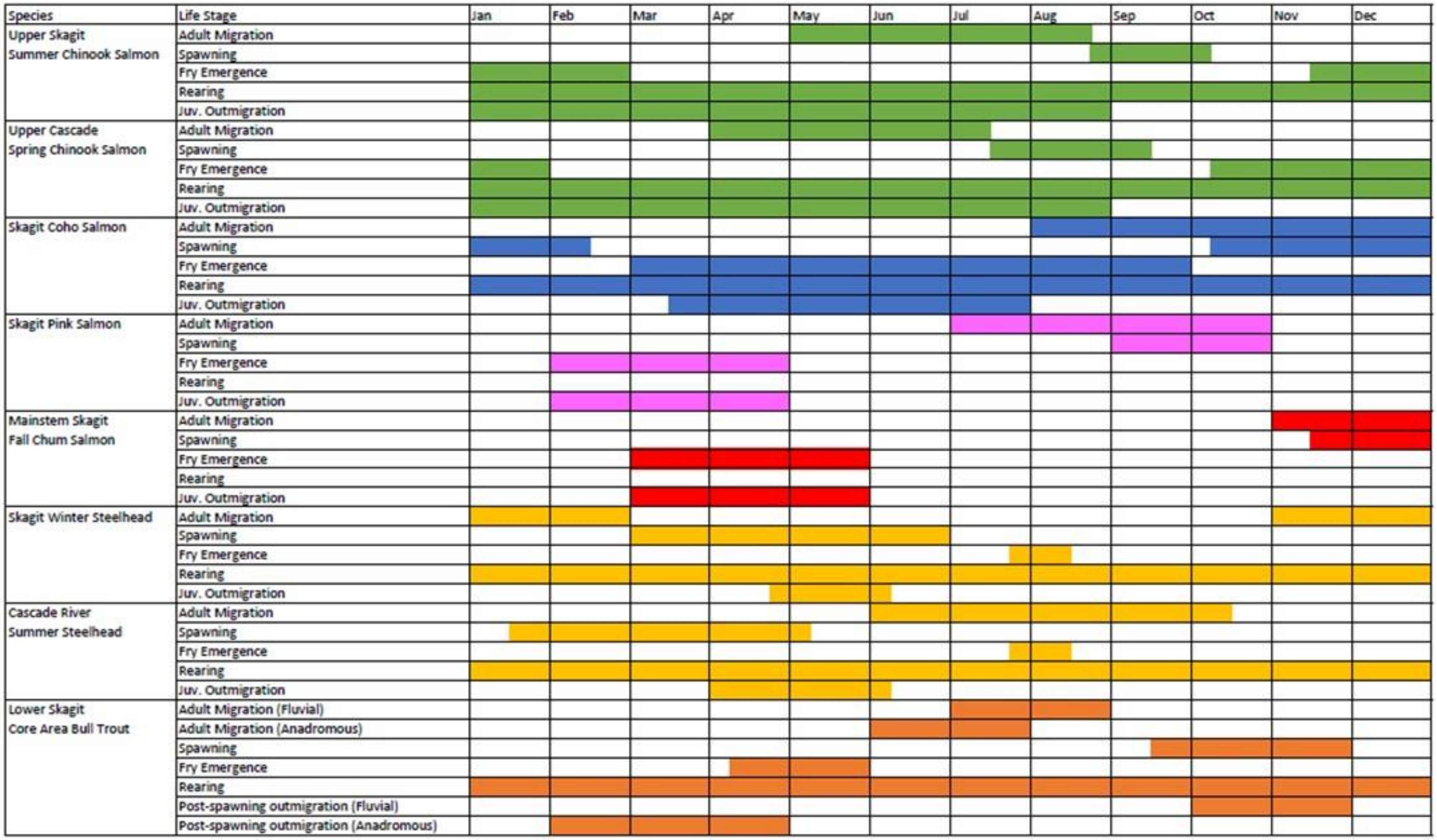
Species	Spawning Habitat	Skagit River Basin Spawning Period	Juvenile Rearing Habitat	Optimal / Max Rearing Temp	Typical Lifespan (years)
Anadromous Fish					
Spring Chinook (stream-type) Summer Chinook (ocean-type) Fall Chinook (ocean-type)	Near deep pools and in areas with abundant instream cover, gravel, and sub-gravel flow.	Mid-July through September Late August through early October Late September through October	Fry either move directly into the estuary or take up residence in the lower velocity margins of the stream or river. These often contain instream cover (wood, root wads, overhanging vegetation or undercut banks).	12 to 14°C/ 26.2°C	Variable life span. Sexually mature between 2 and 7 years old, typically return to spawn when 3 or 4 years old. Die after spawning.
Coho Salmon	Low-gradient areas throughout the watershed, including urban drainage ditches, mainstem side channels, small and large tributaries, and low-gradient spawning habitat within high-gradient mountain streams.	Early October through mid-February	Juveniles prefer shallow, low velocity backwater pools, dam pools, and beaver ponds. Often associated with cover such as overhanging or submerged logs, undercut banks, overhanging vegetation, or large substrate.	12-14°C/ 26.0°C	Over 95 percent mature in their third year of life. Die after spawning.
Pink Salmon	Spawn in odd-number years in the lower reaches of rivers and streams. Most spawning occurs in riffles. Avoid spawning in deep, slow-moving water or on sandy, or heavily silted, substrate.	September through October	Pink Salmon use freshwater almost exclusively as a spawning and incubation environment, moving downstream to the ocean or estuary almost immediately after emergence in March and April.	N/A for freshwater (Downstream migration occurs at 6 to 7°C)	Obligate 2-year life cycle. Die after spawning.
Chum Salmon	Shallow, low gradient, low velocity streams and side channels. Sub-gravel flow (upwelled groundwater) may also be important in the choice of redd sites.	Mid-November through December	Emerge from the gravel in the spring and migrate to saltwater almost immediately following emergence. However, they may reside in freshwater for as long as a month.	12 to 14°C/ 25.4°C	Between 3 and 5 years of age. Die after spawning.

Species	Spawning Habitat	Skagit River Basin Spawning Period	Juvenile Rearing Habitat	Optimal / Max Rearing Temp	Typical Lifespan (years)
Sockeye Salmon	Some populations spawn in rivers while other populations spawn along the beaches of their natal lake (i.e., Lake Ozette), typically in areas of upwelling groundwater. Also spawn in side channels and spring-fed ponds.	Late September through December, peaking late October to late November.	After fry emerge from the gravel, most migrate to a lake for rearing, although some types of fry migrate directly to the sea. Lake rearing ranges from 1-3 years.	12 to 14°C/ 25.8°C	Rear for up to 3 years in freshwater; return to spawn after spending up to 4 years in saltwater. Die after spawning.
Skagit Winter Steelhead and Rainbow Trout	Cool, clear, and well oxygenated streams. Redd sites are located at pool tail-outs. These areas are often associated with deep pools and abundant instream cover.	March through June	Steelhead and Rainbow Trout prefer relatively small, fast flowing streams with a high proportion of riffles and pools.	10 to 13°C/ 23.9°C	Commonly spend 2 to 3 years in saltwater before spawning.
Bull Trout	Low gradient stream reaches with loose, clean gravel, near springs or other sources of cold groundwater. Typically, spawning commences in the fall as water temperatures decline, approaching 8°C.	Mid-September through November	Stream bottoms with cool water temperatures, abundant riparian vegetation, pools, boulders, and low water velocities. May become anadromous as an adult or subadult.	15.8 to 17.5°C/ 21°	Reach sexual maturity in 4 to 7 years and may live longer than 12 years. Variable duration of occupancy in freshwater and marine environments.
Cutthroat Trout	Low gradient riffles and in shallow pool tail-outs. Prefer clean pea-sized to walnut-sized gravel located near deep pools, which are presumed used by adults for cover. Flow in spawning streams seldom exceeds 10 cfs during the low flow period.	Spring spawners. Spawning time depends on latitude, altitude, water temperature, and flow conditions.	Fry prefer low velocity stream margin, backwater, and side channel habitat with abundant instream cover. Yearlings disperse throughout the mainstem.	10°C/ 22.8°C	Reach sexual maturity at age 4 and 5, following their first year in the marine environment.
Pacific Lamprey	Headwaters of both large and small streams in low gradient, sandy gravel areas located at the upstream end of riffles.	April to July when water temperatures are between (10 and 16°C).	Larval Lamprey (ammocoetes) reside for several years in fine silt deposits in quiet backwater areas of streams. They then stay burrowed for 4 to 6 years, moving only rarely to new areas.	14°C/ 25°C	2 to 3 years in the marine environment.

Species	Spawning Habitat	Skagit River Basin Spawning Period	Juvenile Rearing Habitat	Optimal / Max Rearing Temp	Typical Lifespan (years)
Resident Fish					
Cutthroat Trout (upstream of Gorge)	Riverine; redds dug in gravel substrates found in pool tailouts.	March to July	Resident: Stream pools with gravel, rubble, or boulder substrate; overhead cover. Adfluvial: Same as resident for one to four years; older fish throughout lake habitats.	15.5°C/21°C	4 to 5 years
Rainbow Trout (upstream and downstream of Gorge)	Cool, clear, and well oxygenated streams. Redd sites are located at pool tail-outs. These areas are often associated with deep pools and abundant instream cover.	March through June	Rainbow Trout prefer relatively small, fast flowing streams with a high proportion of riffles and pools.	10 to 13°C/ 23.9°C	4 to 5 years
Bull Trout (upstream and downstream of Gorge)	Low gradient stream reaches with loose, clean gravel, near springs or other sources of cold groundwater. Typically, spawning commences as water temperatures approach 8°C.	Mid-September through November	Stream bottoms with cool water temperatures, abundant riparian vegetation, pools, boulders, and low water velocities. May become anadromous as an adult or subadult.	15.8 to 17.5°C/ 21°	Reach sexual maturity in 4 to 7 years and may live longer than 12 years. Variable duration of occupancy in freshwater and marine environments.
Dolly Varden (upstream of Gorge)	Riverine; redds dug in gravel substrates found in pool tailouts. Typically in upper reaches of accessible tributary habitats.	September to November	Lakes and streams	2 to 16°C/ Above 18°C	Unknown
Brook Trout (upstream of Gorge)	Riverine; redds dug in gravel substrates found in pool tailouts.	August to September	Lakes and streams	14 to 16°C/ 29.8°	Up to 6 years
White Sturgeon (downstream of Gorge)	Spawning activity is reported to occur over rocky substrate in swift currents near rapids or waterfalls. Mud or silt is critical in preventing the clumping (reducing adhesiveness) and subsequent suffocation of eggs.	May through June.	Relatively deep water with sand substrate	10 to 18°C/ Not available	Over 100 years.

Species	Spawning Habitat	Skagit River Basin Spawning Period	Juvenile Rearing Habitat	Optimal / Max Rearing Temp	Typical Lifespan (years)
Mountain Whitefish (downstream of Gorge)	Coarse substrates in the lower reaches of large tributaries or in the mainstem of large rivers. No nest or redd is prepared; rather, the eggs (which are adhesive) are scattered over the substrate.	October to December	Mainstem riffles and runs. Undergo seasonal migrations between feeding and overwintering habitats, but these typically do not exceed a few miles.	8.9 to 11.1°C/ Not available	Few live longer than 12 years.
Redside Shiner (upstream and downstream of Gorge)	Gravel stream bottoms or vegetation along lake shorelines. Fertilized eggs adhere to the substrate.	April to July. Begins when temperatures reach 10°C	Runs and standing pools of headwaters, creeks, and small to medium rivers as well as lakes and ponds. Usually found over mud or sand, often near vegetation.	14 to 18°C/ 24°C	Up to 7 years
Longnose Dace (downstream of Gorge)	Very fast riffles over shallow gravel.	May to August	Rocky streams with extremely steep gradients and very swift currents. They can also be found in large lakes with rocky wave swept shorelines.	Not available/ 22 °C	2 to 5 years
Sucker spp. (downstream of Gorge)	Riverine; Pool tailouts with fine gravel and sand substrate; occasionally in riffles and along shoreline of lakes.	Mid-May through July	Lakes and streams; shallow weedy areas during the day, deeper offshore areas at night.	Not available/ 27°C	8 to 19 years
Three-spine Stickleback (downstream of Gorge)	Ponds, rivers, lakes, drainage canals, marshes, sloughs, tidal creeks, and sublittoral zones.	Late April to July	Shallow areas with sand, algae, macrophytes, and various debris.	Not available/ 25°C	1 to 3 years
Sculpin spp. (downstream of Gorge)	Under flat-bottomed rocks, waterlogged wood or other rubble found in stream beds.	February to June	Lakes and streams; benthic; rubble, gravel, or rocky substrates.	13 to 18°C/21°C	4 to 5 years

Sources: Sandercock 1991; Healey 1991; Salo 1991; Scott and Crossman 1973; Wydoski and Whitney 2003; Bell 1986; Bjornn and Reiser 1991; Barnhart 1991; Trotter 1991; Mallat 1983; Ihnat and Bulkley 1984; Goetz 1989; Federal Register (FR), Vol. 64, 1 November 1, 1999; Conte et al. 1988, Mesa et al. 2013, Takami et al. 1997, and Burgner 1991; McPhail and Taylor 1995.



Sources: Weitkamp et al. 1995; Connor and Pflug 2004; City Light 2011; Lowery et al. 2013; Zimmerman et al. 2015; and WDFW 2019.

Figure 4.5-1. Life history stage timing for salmonids in the upper Skagit River.

4.5.1.1 Geologic Conditions, Connectivity, and Potential Origins of Salmonids in the Upper Skagit River Basin

As noted in Section 4.3 of this PAD, both local and regional drainage patterns in the Skagit River basin have been altered by glaciation (Riedel et al. 2007). The North Cascade Range and Puget Lowlands were inundated by the south-flowing Cordilleran Ice Sheet during the Fraser Glaciation 35 to 11.5 thousand years ago. The Cordilleran Ice Sheet that advanced into the area from the north was greater than one mile thick at Ross Lake and the Puget Lowland (Armstrong et al. 1965; Porter and Swanson 1998). Glacial ice dams blocked the northerly flowing Skagit River and created lakes that drained to the south, forming deep canyons. After the ice sheet retreated, the Skagit River and nearby creeks were redirected to flow south in their current configuration (Riedel et al. 2012). Prior to this redirection, the upper Skagit River is thought to have been a tributary to the Fraser River (Riedel et al. 2007).

Smith (2019) indicated that Bull Trout populations in the Upper Skagit Core area are the result of a founding population from the Fraser River. Smith (2019) based this conclusion on an analysis of mitochondrial haplotypes of Bull Trout from the Fraser and Skagit Rivers, and low allelic richness of Upper Skagit Bull trout indicating a founder effect. Smith (2019) suggests that the most likely mechanism for dispersal into the Skagit River above the current location of Gorge Dam is through the upper Skagit River from the Fraser River; this pathway is corroborated by Riedel et al. (2007). This is consistent with the fact that Bull Trout and Rainbow Trout below Gorge Dam are genetically distinct from those in the upstream reservoirs (Smith 2010; Small et al. 2016), and Dolly Varden only occur upstream of the Skagit River Gorge. Rainbow Trout in Stetattle Creek are also genetically distinct from steelhead in the Skagit River (Kassler and Warheit 2012, as cited in Pflug et al. 2013). These genetic differences coupled with the geologic history of the basin strongly suggest that salmonids in the upper Skagit River basin originated in the Fraser River.

Downen (2014) agrees that compelling evidence exists to support the hypothesis that the upper Skagit River once flowed into the Fraser River, and states that native char (Dolly Varden and Bull Trout) and Rainbow Trout in the upper Skagit River basin may have originated in the Fraser River. As described in Downen (2014), a recent analysis conducted by WDFW (Kassler and Warheit 2012, as cited in Pflug et al. 2013) found that Rainbow Trout in Ross, Diablo, and Gorge lakes are similar to each other, supporting the agency’s management of these fish as a single population. However, they are genetically distinct (cluster separately) from steelhead in the lower Skagit River watershed and other headwater resident Rainbow Trout populations (Pflug et al. 2013). Prior to the construction of Ross Dam, gene flow from the upper Skagit into the lower Skagit was likely only one-way (upstream to downstream) following the redirection of the Skagit River’s flow to the south approximately 15,000 years ago (Downen 2014).

The Skagit River Gorge (the gorge) is a narrow section of the Skagit River that begins just upstream of Newhalem, where the river flows through a confined canyon with steep rock walls. Following the geologic connection of the upper and lower Skagit River basins (as described above) after the retreat of glaciation, the Skagit River flowed south through this gorge through high drops and cascades. Historically, Smith and Anderson (1921) stated that “salmon have been seen [no more than] about one mile above the City of Seattle Camp (i.e., current Town of Newhalem at RM 94). Also in 1921 the Washington State Fish Commission stated, “no salmon have been observed at any time more than one-half mile above City of Seattle Camp (i.e. the first barrier 0.6 mi above

Gorge Powerhouse (Envirosphere 1989; Smith and Anderson 1921)." NMFS (2012) also concluded that, "Natural barriers blocked the upstream passage of anadromous fish through [what is now] the Project area. These natural barriers include numerous falls, bedrock cascades, and velocity barriers in the 2.5-mile reach located between Gorge Powerhouse and Gorge Dam, and a narrow bedrock constriction and falls located near Diablo Dam." NMFS (2012) further states "While some historical use of areas upstream from the Gorge by steelhead is suggested by anecdotal information gathered at the time of construction (~1927), the preponderance of evidence indicates limited historical anadromous fish use of the Skagit River watershed upstream from the present location of the Gorge Powerhouse."

With construction of the Project, water in the Skagit River was diverted at Gorge Dam into a tunnel to the powerhouse, completely bypassing the gorge except during spill events. This 2.5-mile section from the dam to the powerhouse is now known as the Gorge bypass reach.

The upper extent of salmon access in the Skagit River has been more definitively identified since the Smith and Anderson (1921) report, i.e., at approximately 0.6 miles upstream of the Gorge Powerhouse (Enviroshere 1989) within this bypass reach. At this location, a boulder cascade barrier with a nine-foot vertical drop has been documented where neither the plunge pool depth nor vertical height of the drop were predicted, based on accepted methodologies for assessing fish passage (Powers and Osborne 1985), to allow for upstream passage of any salmonid species except steelhead and perhaps Chinook Salmon under higher flows. A second boulder cascade series presumed to represent a velocity barrier of less restrictive conditions occurs at approximately 1.3 miles upstream of the powerhouse (Envirosphere 1989). Envirosphere (1989) concluded, "...passage through the Gorge reach would be difficult for fish. Fish migration would only occur during a limited range or 'window' of flows. Discharges below this flow range would prevent the formation of localized plunge pools necessary for leaping. Discharges above this flow range would result in velocity barriers through narrow canyon sections."

Fish use survey results in the bypass reach (Envirosphere 1989; Upper Skagit Indian Tribe 2016) and Bull Trout genetic studies (Smith 2011; Small et al. 2016), support the conclusion that the lowermost barrier 0.6 miles upstream of the powerhouse historically blocked the further upstream movement of salmon and Bull Trout in the Skagit River. In 2016, live steelhead, steelhead redds, and Coho Salmon fry were seen below the lowermost barrier, whereas juvenile Rainbow Trout were found throughout the bypass reach (Upper Skagit Indian Tribe 2016).[25] Further field reconnaissance on October 24, 2019 by a team of City Light, WDFW, Upper Skagit Indian Tribe, and NPS biologists observed no adult steelhead anywhere in the bypass reach (as expected given

[25] Surveys of the bypass reach were conducted on May 9 and June 17, 2016. The May 2016 survey extended from Gorge Powerhouse to about 1.5 miles upstream in the bypass reach. During the survey, snorkelers recorded the number of fish, by species and size-class, and redds in each distinct habitat area. Four adult steelhead and four steelhead redds were observed, all downstream of the barrier located 0.6 miles upstream of the powerhouse. No adult steelhead or redds were observed upstream of the barrier. Numerous Coho Salmon fry were observed in the bypass reach up to about 0.6 miles upstream of the powerhouse; no Coho fry were observed above the barrier located 0.6 miles above the powerhouse. Seven juvenile Rainbow Trout/steelhead were observed in pools below and within the fish passage barrier at 0.6 miles upstream of the Gorge Powerhouse, and five juvenile Rainbow Trout/steelhead were observed in a pool located immediately upstream of the barrier; these fish likely originated in Gorge Lake and were passed downstream during a spill event (Connor 2016). During the June 2016 survey, no steelhead or additional steelhead redds were observed; juvenile Rainbow Trout/steelhead and one Eastern Brook Trout were observed above the barrier in June.

their spring spawning behavior), but three schools of live Coho Salmon, several Pink Salmon carcasses and redds, and one Chinook Salmon carcass and redd were observed below the first barrier. In contrast, several juvenile Rainbow Trout, Brook Trout, and native char were angled or electrofished upstream of the second barrier (located about 1.3 miles upstream of the powerhouse). Under high flow conditions small numbers of steelhead may have historically been able to move upstream of these barriers (Smith and Anderson 1921; Envirosphere 1989; NMFS 2012; NMFS 2018). During the previous Project relicensing, City Light conducted an assessment of historical records containing WDFW accounts in the Project vicinity (Envirosphere 1988). From review of the historical records, Envirosphere concluded that, "Some historical evidence suggests that small runs of steelhead trout migrated as far as Stetattle Creek...". Given potential passage by steelhead above the lowermost barrier, it cannot be determined with current information whether the juvenile Rainbow Trout observed upstream of the passage barriers in the recent bypass reach fish use surveys were derived from anadromous steelhead that had ascended the bypass reach barriers and spawned above them but below Gorge Dam, or represented Rainbow Trout that emigrated from Gorge Lake; it is presumed the Brook Trout and native char were passed downstream from Gorge Lake.

4.5.1.2 Anadromous Fish

Chinook Salmon

General Life History and Habitat Requirements

Throughout their range, Chinook Salmon exhibit diverse and complex life histories. Variation exists 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 these differences are displayed in two distinct freshwater juvenile rearing behaviors commonly referred to as "stream-type" and "ocean-type". Stream-type Chinook rear in freshwater for up to a year or more before migrating to sea, perform extensive offshore migrations, and return to their natal river in spring, summer, or autumn prior to spawning. Ocean-type Chinook migrate to sea in their first year of life, usually only a few months after emergence from the gravel, remain in nearby coastal areas, and typically return to their natal river in the late summer or fall, a few days or weeks before spawning.

Returning adult offspring of ocean-type Chinook Salmon typically prefer to spawn in the middle and lower mainstem areas of large rivers, while returning offspring of stream-type Chinook tend to spawn in middle and upper reaches of smaller mainstem and larger tributary areas (Table 4.5-2) (Healey 1991). Favored spawning sites for both life histories are located near deep pools and in areas with abundant instream cover. Adequate spawning area and sub-gravel flow are very important in the choice of redd sites. Once in the gravel, incubating salmon eggs require a relatively stable stream channel, adequate intragravel percolation rates (i.e., limited siltation), relatively high dissolved oxygen concentrations, and adequate water depth above the redd. High flows can displace the streambed containing the redd, or fine sediments can be deposited in the egg pocket, interfering with the supply of oxygen and the removal of metabolic waste products.

Immediately following emergence from the gravel, Chinook fry (young juveniles) either swim or are displaced downstream. They then either move directly into the estuary or take up residence in the lower velocity margins of the stream or river. These low velocity areas often contain instream cover in the form of wood, root wads, overhanging vegetation, or undercut banks (Healey 1991).

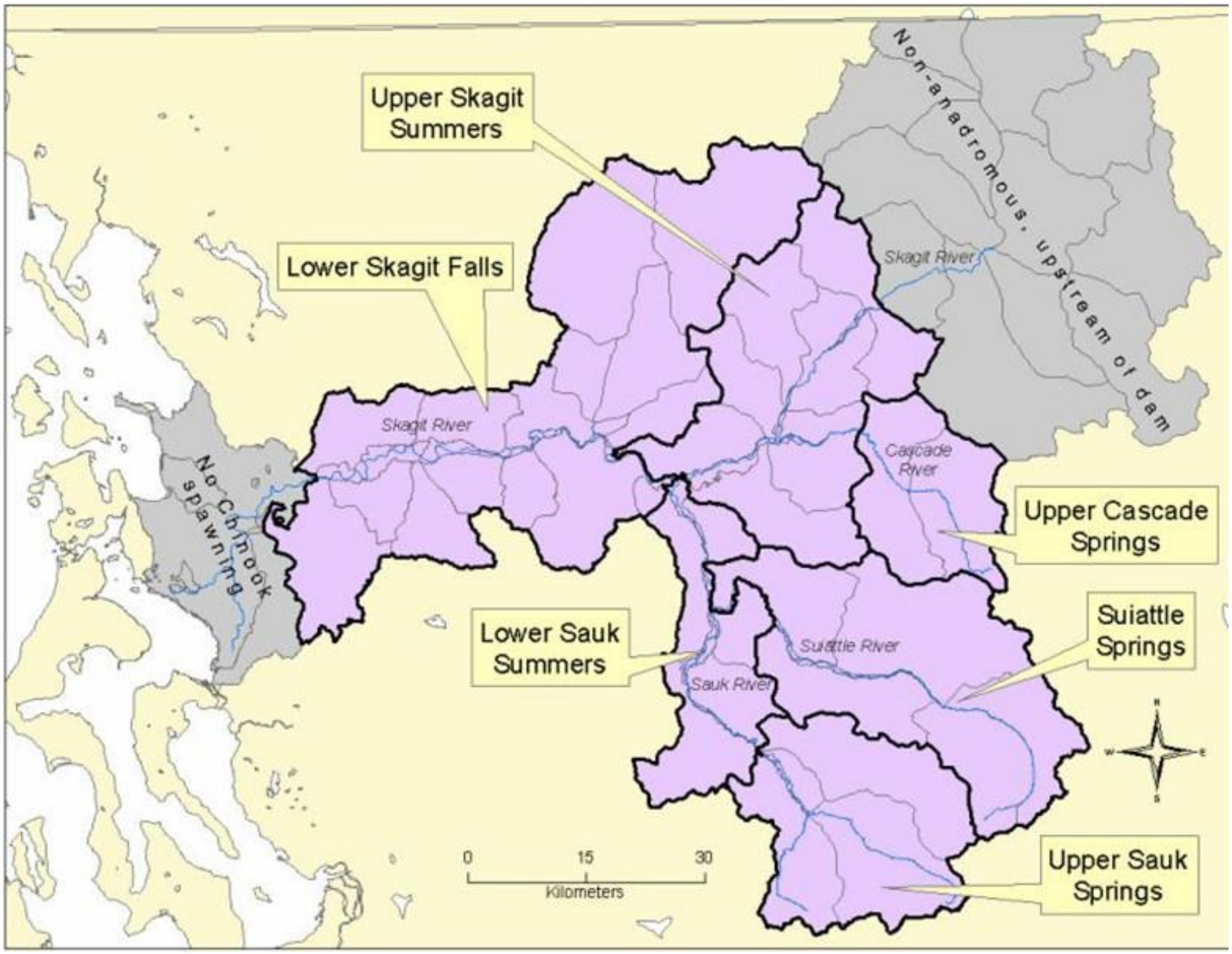
As juvenile Chinook grow, they tend to move into the deeper, higher velocity portions of the channel (Myers et al. 1998).

Naturally produced ocean-type Chinook usually migrate to the estuary during one of three distinct phases: immediately after yolk reabsorption; 60 to 150 days after yolk absorption; or after one full year in freshwater (Myers et al. 1998). The duration of ocean residence for both stream-type and ocean-type Chinook ranges from one to six years; however, a small proportion of male Chinook return to freshwater after two to three months in saltwater. Puget Sound stocks tend to mature at ages three to four (Myers et al. 1998).

NMFS (2016) identified limiting factors for Puget Sound Chinook Salmon, although not specifically for the Skagit River. Many factors, such as tidal delta habitat conditions, ocean survival, and harvest/poaching, may affect the listing and recovery status of Skagit River Chinook Salmon. Limiting factors for Skagit River Chinook Salmon were identified as life-stage recruitment levels, degraded riparian zones, poaching, dam operations, sedimentation and mass wasting, flooding, high water temperatures, hydromodification, water withdrawals, loss of delta habitat and connectivity, loss of pocket estuary habitat and connectivity, availability of prey fish species, habitat destruction and degradation, and high seas survival (SRSC and WDFW 2005). A summary of the potential limiting factors affecting recovery of Chinook in the Skagit River is presented in Section 4.5.3.1.

Distribution, Abundance, and Demographics in the Skagit River Basin

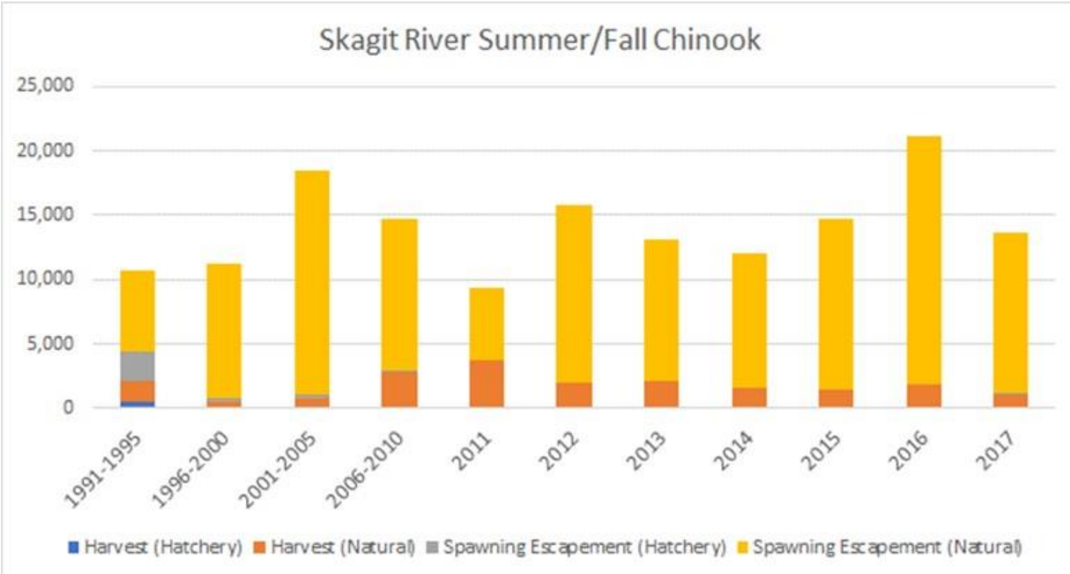
The Puget Sound Technical Recovery Team identified 22 independent Chinook Salmon populations within five biogeographic regions in the Puget Sound Evolutionarily Significant Unit (ESU) (Ruckelshaus et al. 2006). The Skagit River watershed includes six of these populations: (1) Lower Skagit Fall Chinook Salmon; (2) Upper Skagit Summer Chinook Salmon; (3) Lower Sauk Summer Chinook Salmon; (4) Upper Sauk Spring Chinook Salmon; (5) Suiattle Spring Chinook Salmon; and (6) Upper Cascade Spring Chinook Salmon (Figure 4.5-2). Each are considered “demographically independent populations” (DIP) that were identified using distinct trends in population abundance and variability, genetic separation, differences in life history characteristics and age structure, spatial and/or temporal separation of spawners, unique habitat and hydrological characteristics of a watershed, and catastrophic risk (e.g., drainage located near a volcano) (PSTRT 2005). The Skagit River and its tributaries upstream of the Sauk River support two of these populations, Upper Skagit Summer Chinook Salmon and Upper Cascade Spring Chinook Salmon; however, there is some overlap in the distribution of Upper Skagit Summer Chinook and Lower Skagit Fall Chinook near the confluence with the Sauk River (WDFW 2019). SRSC and WDFW (2005) determined that all populations of Chinook Salmon in the Skagit River produce both ocean- and stream–type juveniles.



Source: SRSC and WDFW 2005.

Figure 4.5-2. Skagit River basin Chinook Salmon populations.

In February 2019, the Pacific Fishery Management Council (PFMC) conducted a review of ocean salmon fisheries throughout the Pacific Coast, including the Skagit River Summer/Fall Chinook stocks, to help assess salmon fishery management performance, the status of the area's salmon stocks, and the socioeconomic impacts of salmon fisheries (PFMC 2019). This review examined the total run of Skagit Summer/Fall Chinook to assess how well system-wide conservation and management objectives were being met. The review summarized total ocean harvest by commercial net and troll (treaty Indian and non-Indian) fisheries, and the escapement to the spawning grounds of both hatchery and natural origin fish (Figure 4.5-3). Harvest and escapement numbers for Chinook Salmon from the Lower Skagit, Upper Skagit, and Sauk River populations were consolidated, but an assessment of the exploitation of spring Chinook populations was not provided. Evaluating the harvest and spawning escapement of all the Summer/Fall Chinook stocks in the Skagit River as a whole, rather than dividing the system by individual populations, allows for an assessment of the productivity of the entire ecosystem for these combined Chinook stocks.



Source: PFMC 2019.

Figure 4.5-3. Ocean commercial net harvest and spawning escapement of hatchery and natural Summer/Fall Chinook Salmon in the Skagit River.

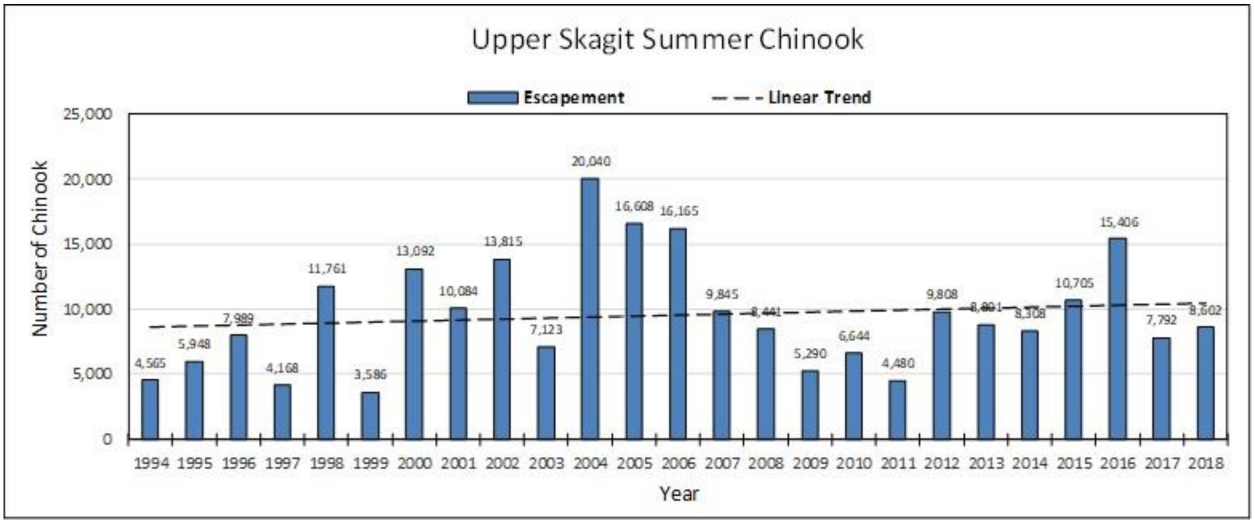
The average Puget Sound run size (defined by PFMC as the run available to Puget Sound net fisheries, i.e., spawning escapement plus Puget Sound net fishery catch, not including fish caught by troll and recreational fisheries inside Puget Sound) of Skagit River Summer/Fall Chinook Salmon from 1991 to 2017 was 14,096 hatchery and natural origin fish. The median over the same time period was 13,693 fish, ranging from a single-year terminal run size low of 9,310 fish in 2011 to a single-year high of 21,184 in 2016 (PFMC 2019).

The number of commercial net catches for Skagit River Summer/Fall Chinook ranged from a single-year high of 3,706 hatchery- and natural-origin fish in 2011, to a single year low of 1,023 fish in 2017. Harvest of the Skagit Summer/Fall Chinook run available to Puget Sound net fisheries (spawning escapement plus ocean commercial net catches), not including fish caught by troll and recreational fisheries in Puget Sound, ranged from a single-year high of 39.8 percent in 2011, to a single year low of 7.5 percent in 2017. Harvest percentages were also low over the 1996 to 2000 (4.2 percent) and 2001 to 2005 (4.4 percent) periods. Average harvest percentage of Skagit River Summer/Fall Chinook from 1991 to 2017 was 14.0 percent.

Upper Skagit Summer Chinook Salmon

Upper Skagit Summer Chinook Salmon spawn in the Skagit River mainstem and its tributaries upstream of the confluence with the Sauk River (SRSC and WDFW 2005; WDFW 2002). Important tributaries include the lower Cascade River, and Illabot, Diobsud, Bacon, and Goodell creeks (Figure 4.5-2). Spawning begins in late August, but primarily occurs in September to early October, which is somewhat earlier than the Lower Skagit Fall Chinook Salmon population (Figure 4.5-1). The upper extent of spawning is near the Gorge Powerhouse. Historically, the series of chutes and falls in the gorge upstream of Newhalem was a natural barrier to anadromous fish as described above.

Data[26] collected since the issuance of the current Project license, indicate the Upper Skagit Summer Chinook Salmon population had a geometric mean escapement of 8,663 fish for return years 1994 to 2018, and 9,651 fish for return years 2013 to 2018 (Figure 4.5-4).



Source: WDFW 2019.

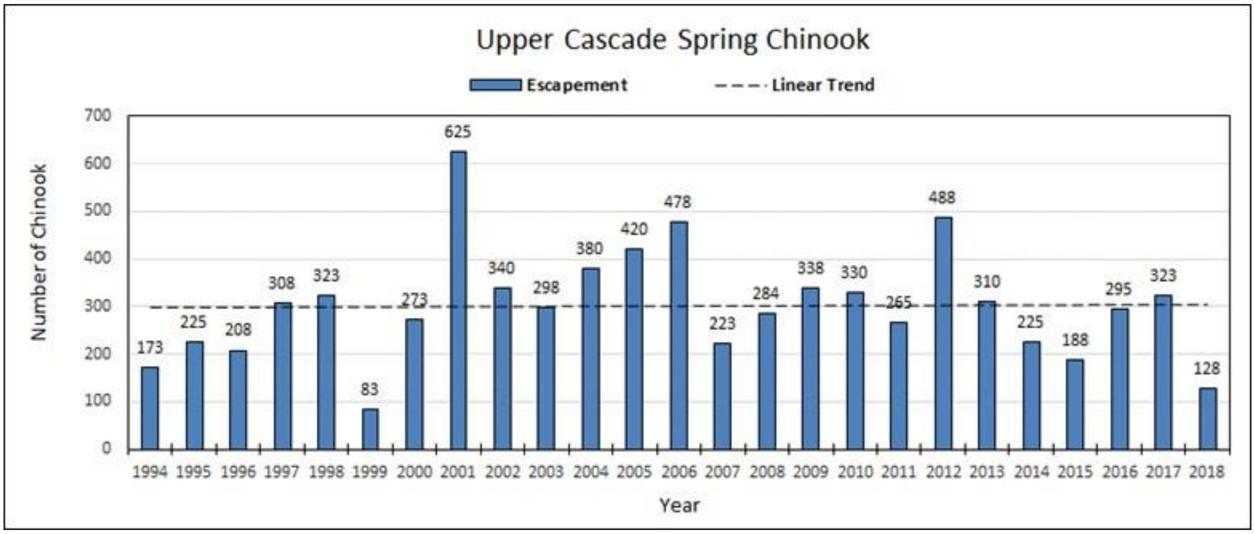
Figure 4.5-4. Upper Skagit Summer Chinook Salmon spawning escapement (1994-2018).

<u>Upper Cascade Spring Chinook Salmon</u>

Upper Cascade Spring Chinook Salmon spawn in the Cascade River mainstem and larger tributaries upstream of RM 7.8 and the end of the canyon near Lookout Creek (SRSC and WDFW 2005; WDFW 2002). Tributaries to this part of the Cascade River are typically steep. Spring Chinook Salmon may use the lower valley floor reaches of the larger tributaries such as Marble, Sibley, Found, Kindy, and Sonny Boy creeks, and the North Fork and South Fork Cascade River for spawning (WDF 1975; WDFW 2002) (Table 4.5-2). River entry from saltwater begins in April and spawning occurs in mid-July through mid-September (Figure 4.5-1).

The geometric mean escapement for return years 1994 to 2018 was 278 fish for the Upper Cascade Spring Chinook Salmon population (Figure 4.5-5). The geometric mean escapement for return years 2013 to 2018 was 233 fish.

[26] Escapement reflects the number of fish returning to the spawning grounds (i.e., it does not include fish that are harvested in commercial or recreational fisheries).



Source: WDFW 2019.

Figure 4.5-5. Upper Cascade Spring Chinook Salmon spawning escapement (1994-2018).

Coho Salmon

General Life History and Habitat Requirements

In Washington, Oregon, and California, over 95 percent of the Coho Salmon mature in their third year of life and migrate from the sea into their streams of origin in the late summer or fall. Throughout their range, spawning typically occurs from early-September through February, depending on the stock. After emergence, juvenile Coho spend from one to two years in freshwater before becoming smolts and migrating to saltwater. Maturing Coho usually rear in the marine environment for approximately 18 months prior to returning to their stream of origin for spawning, although a variable proportion of males (jacks) return to freshwater to spawn after only five to seven months in the ocean (Weitkamp et al. 1995).

Optimum Coho Salmon habitat is considered to be streams with widths of 3- to 16-feet, gradients less than three percent, pool to riffle ratios of 1:1, and vegetative canopy closures of 50 to 75 percent (McMahon 1983) (Table 4.5-2). Coho usually spawn in the gravelly transition areas between pools and riffles and spawning areas are often located close to cover that provides protection from predation on the spawning female. As with other salmonids, successful incubation of Coho eggs 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 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 and beaver ponds (Reeves et al. 1989). Often Coho fry are 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, offering increased food sources for the young fry. 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). During the winter, juvenile Coho move into side channels and backwater channels, especially those areas with heavy groundwater influence.

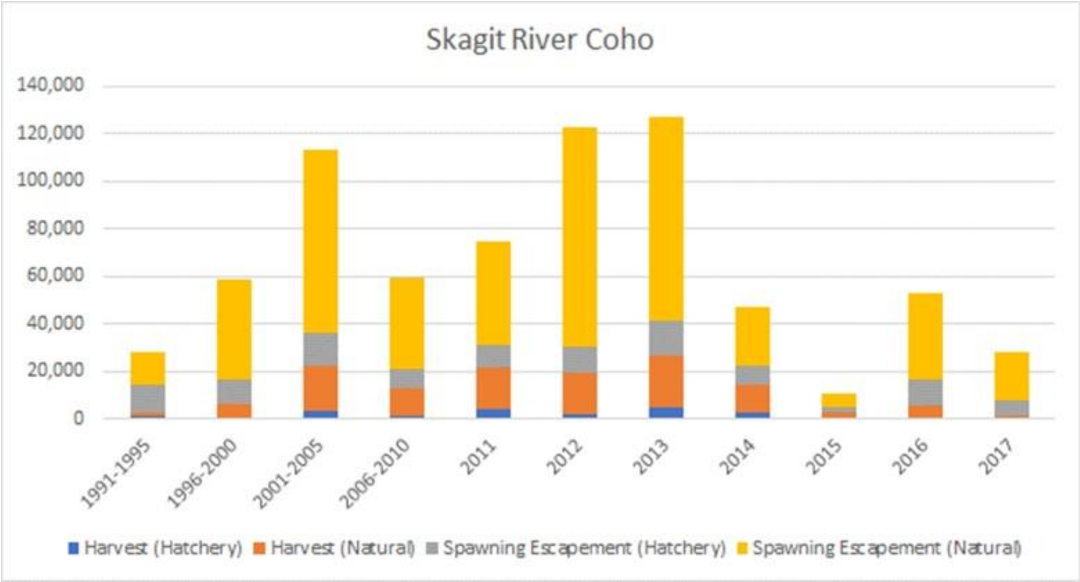
Although a detailed assessment of potential Coho Salmon limiting factors has not been developed for the Skagit River basin, Woodward et al. (2017) did create a model to synthesize the current understanding of key ecological processes through the life cycle of Coho Salmon in the Skagit River basin. These model inputs are listed below, and can be considered potential limiting factors for Puget Sound Coho Salmon:

- Summer low flows
- Winter high flows
- Scouring flows during spawning
- Climate change
- Elevated water temperature
- High seas survival
- Prey availability for juvenile Coho (Pink Salmon)
- Predation on juvenile Coho (by Pink Salmon)
- Habitat availability
- Suspended sediments
- Harvest

Distribution, Abundance, and Demographics in the Skagit River Basin

Coho Salmon are native to the Skagit River basin and the WDFW has identified two stocks within the Project vicinity: Skagit River Coho and Baker River Coho (WDF, WDFW and Western Washington Treaty Indian Tribes [WWTIT] 1994). Adult Skagit River Coho generally spawn in the tributaries to the Skagit River, although some spawning may occur in side channels and sloughs along the mainstem. Juvenile Coho are present throughout the year in the mainstem Skagit River, rearing in pools and off-channel habitats. Skagit River Coho spawn from early October through mid-February.

PFMC's review of Pacific Coast ocean salmon fisheries included Skagit River Coho Salmon (PFMC 2019). This review examined the total Coho Salmon run to the Skagit River to consider how system-wide conservation and management objectives were being met. The assessment summarized total ocean harvest by commercial net and troll (treaty Indian and non-Indian) and escapement to the spawning grounds of both hatchery- and natural-origin Coho (Figure 4.5-6). Harvest and escapement numbers represent Coho Salmon from the entire Skagit River, including the Baker River population.



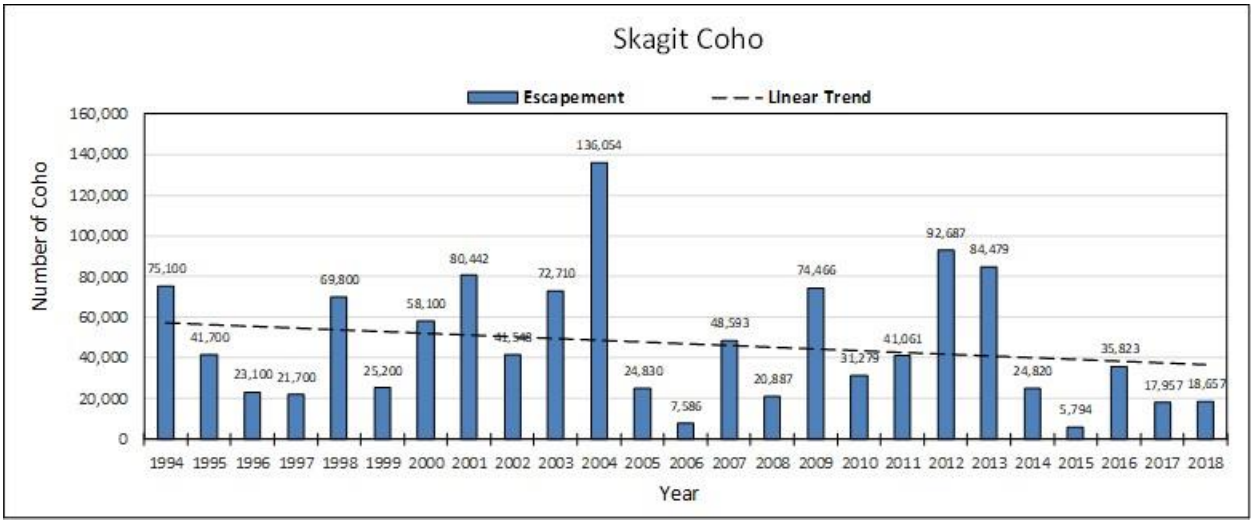
Source: PFMC 2019.

Figure 4.5-6. Ocean commercial net harvest and spawning escapement of hatchery and natural Coho Salmon in the Skagit River.

The average terminal run size of Skagit River Coho Salmon from 1991 to 2017 was 199,761 hatchery- and natural-origin fish. The median over the same time period was 203,629 fish, ranging from a single-year terminal run size low of 64,223 fish in 2015 to a single-year high of 309,701 in 2012 (PFMC 2019).

The number of commercial net catches for Skagit River Coho Salmon range from a single-year high of 26,533 hatchery- and natural-origin fish in 2013, to a low of 780 fish in 2017, with an average of 12,449 Coho from 1991 to 2017. Commercial net catches of the Skagit Coho terminal run size (defined by PFMC as the run to terminal marine areas, spawning escapement plus sport, commercial net catch (in-river and terminal fishery), ranged from a high of 14.8 percent in 2011 to a low of 0.6 percent in 2017. The average commercial net catch of terminal Coho Salmon in the Skagit River was 6.6 percent from 1991 to 2017.

The geometric mean escapement of Skagit River Coho for return years 1994 to 2018 was 36,703 fish (Figure 4.5-7). The geometric mean escapement for return years 2013 to 2018 was 22,942 fish.



Source: WDFW 2019.

Figure 4.5-7. Skagit River Coho Salmon spawning escapement (1994-2018).

Pink Salmon

General Life History and Habitat Requirements

Pink Salmon are distinguished from other Pacific salmon species by their obligate two-year life cycle and relatively small size (weighing an average of four 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 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 eggs usually hatch in early to mid-winter. Following emergence from the gravel, Pink Salmon fry migrate immediately downstream into saltwater. The out-migration is short, peaking in late winter and early spring, and is usually complete by May (Heard 1991). After a few weeks to a few months in estuaries and nearshore habitat, Pink Salmon move offshore, where they migrate at sea for 12 to 16 months (Heard 1991).

Although a detailed assessment of potential Pink Salmon limiting factors has not been developed for the Skagit River basin, Hard et al. (1996) developed a list of extinction risks for odd-year Pink Salmon in Washington, Oregon, and California. These extinction risks are listed below, and can be considered potential limiting factors for Skagit River Pink Salmon:

- Major flooding
- Low water upon river entry and spawning
- Low quality spawning and incubation habitat

- Water withdrawals for irrigation
- Structures for flood control
- Reduced substrate stability and permeability
- Predation on juveniles by Coho Salmon and marine mammals
- Oceanic conditions

Distribution, Abundance, and Demographics in the Skagit River Basin

A native, wild Pink Salmon population spawns in odd years in the mainstem Skagit River and tributaries such as Bacon and Goodell creeks and the Cascade, Sauk, and Suiattle rivers.[27] Spawning generally occurs from September through October from Newhalem (RM 94) downstream to Sedro-Woolley (RM 23), with the heaviest spawning concentrated in the mainstem Skagit River from Marblemount (RM 78) upstream to Newhalem (Figure 4.5-1; FERC 2006).

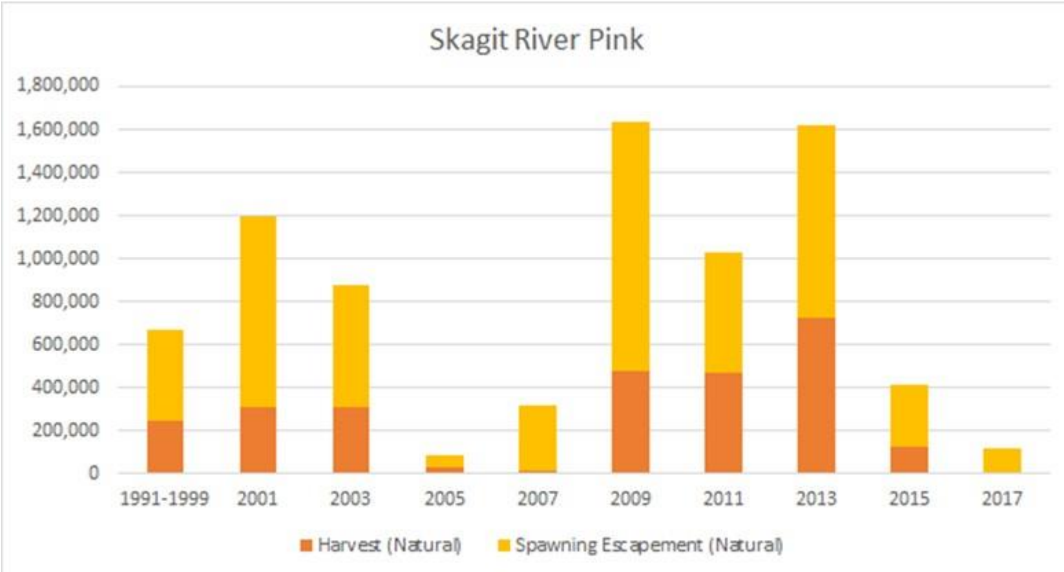
Skagit River Pink Salmon are part of the odd-year Pink Salmon ESU in Washington and southern British Columbia. NMFS reviewed the status of this ESU and ruled on October 4, 1995, that odd-year Pink Salmon were not currently at risk of extinction; therefore, no ESA-listing of the species was proposed (60 FR 51928). WDFW considers this Pink Salmon stock to be healthy, with overall abundance close to historical levels (WDFW and WWTIT 2003).

PFMC’s review of Pacific Coast ocean salmon fisheries included Skagit River Pink Salmon (PFMC 2019). This review included total harvest by commercial net and troll (treaty Indian and non-Indian) and escapement to the spawning grounds of both hatchery- and natural-origin Pink Salmon (Figure 4.5-8).

The average Puget Sound run size (defined by PFMC as the run available to Puget Sound net fisheries; spawning escapement plus Puget Sound net fishery catch, not including fish caught by troll and recreational fisheries inside Puget Sound) of Skagit River Pink Salmon from 1991 to 2017 was 796,485 fish. The median over the same time period was 773,894 Pink Salmon, ranging from a single-year terminal run size low of 85,191 fish in 2005, to a single-year high of 1,638,121 in 2009 (PFMC 2019).

The number of commercial net catches for Skagit River Pink Salmon ranged from a single-year high of 478,121 fish in 2009, to a single-year low of 6,816 fish in 2017. Harvest of the Skagit Pink run available to Puget Sound net fisheries (spawning escapement plus ocean commercial net catches), not including fish caught by troll and recreational fisheries in Puget Sound, ranged from a high of 45.7 percent in 2011 to a low of 4.7 percent in 2007, with an average of 28.7 percent from 1991 to 2017.

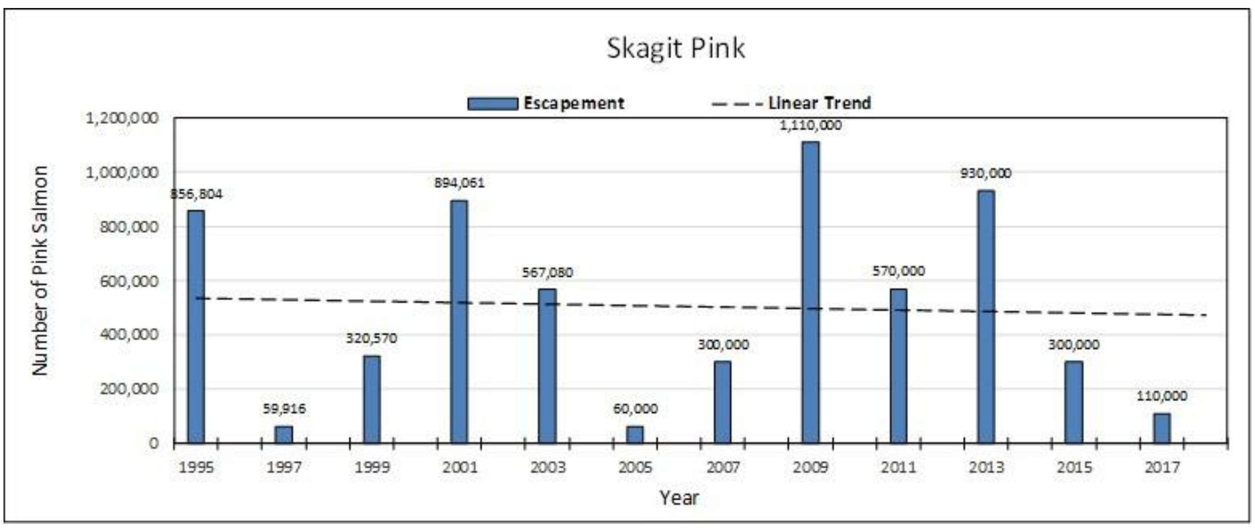
[27] The largest population of Pink Salmon in the contiguous United States is produced in the Skagit River (Connor and Pflug 2004).



Source: PFMC 2019.

Figure 4.5-8. Ocean commercial net harvest and spawning escapement of hatchery and natural Pink Salmon in the Skagit River.

The geometric mean escapement for return years 1995 to 2018 was 345,729 fish for the Skagit River Pink Salmon populations (Figure 4.5-9). The geometric mean escapement for return years 2011 to 2017 was 363,679 fish.



Source: WDFW 2019.

Figure 4.5-9. Skagit River Pink Salmon spawning escapement (1994-2018).

Chum Salmon

General Life History and Habitat Requirements

Chum Salmon enter freshwater at an advanced stage of sexual development and spawn in the lower reaches of coastal rivers, with redds usually dug in the mainstem or in side channels from just above tidal influence. Like Pink Salmon, juvenile Chum Salmon emerge from the gravel in the spring and outmigrate to saltwater almost immediately following emergence (Table 4.5-2) (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. When Chum Salmon enter the estuary, some fry remain near the mouth of their natal river, but most disperse within a few hours into tidal creeks and sloughs up to several miles from the mouth of their natal river (Johnson et al. 1997).

Most Chum Salmon mature between three and five years of age and enter natal river systems from June to March, depending on characteristics of the population or geographic location (Salo 1991). In Washington, a variety of seasonal runs are recognized, including summer, fall, and winter populations; fall-run fish predominate.

Generally, Chum Salmon prefer to spawn in relatively shallow, low gradient, low velocity streams and side channels. Sub-gravel flow (upwelled 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 for redd construction; rather, they most commonly use areas at the head of riffles (Johnson et al. 1997).

Chum Salmon spawn from early November to mid-January (Table 4.5-2). Typically, incubating eggs hatch in about 2 to 18 weeks (Wydoski and Whitney 2003; Johnson et al. 1997). Most Chum Salmon fry 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).

Habitat impacts to summer-run Chum Salmon from the Hood Canal/Eastern Strait of Juan de Fuca ESU, an ESA-listed population, were assessed in the Hood Canal and Easter Strait of Juan de Fuca Summer Chum Salmon Recovery Plan (Brewer et al. 2005). While these habitat impacts are specific to the Hood Canal/Eastern Strait of Juan de Fuca ESU, some of the following may also apply to Skagit River Chum Salmon:

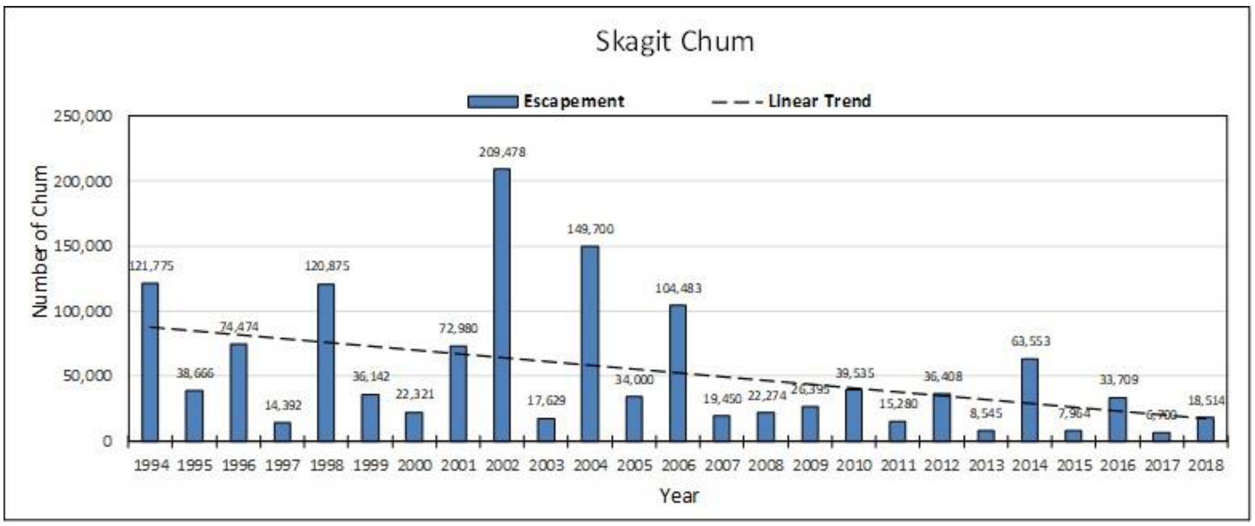
- Climate related changes in stream flow patterns
- Fishery exploitation
- Habitat loss
- Water quantity (low and peak flows)
- Water quality (primarily temperature)
- Riparian forest conditions (width of riparian forest, age of trees, species composition)
- Sediment conditions (aggradation, degradation, presence of fines)
- Loss of channel complexity (LWD quantities, channel condition, loss of side channel habitat, channel instability)
- Access to habitat
- Presence of predators
- Estuarine habitat loss and degradation (diking, filling, log storage, road causeways)

Distribution, Abundance, and Demographics in the Skagit River Basin

WDFW (2002) identified 69 Chum Salmon stocks in the Puget Sound region. Three of these are found in the Skagit River basin: (1) mainstem Skagit Fall Chum; (2) lower Skagit Tributary Fall Chum; and (3) Sauk River Fall Chum. Mainstem Skagit Fall Chum spawn from mid-November through December in the mainstem Skagit River from RM 34 to 93 and in the Cascade River, Nookachamps, Gilligan, Illabot, and Bacon creeks.

All three Skagit Chum populations are of native origin with wild production. The geometric mean of Skagit River Chum Salmon escapement for return years 1994 to 2018 was 34,694 fish (Figure 4.5-10). The geometric mean escapement for return years 2013 to 2018 was 16,201 fish. A regional decline in Chum Salmon was assessed by Malik et al. (2016). That assessment found that Chum Salmon productivity in the marine environment was partially responsible for that decline. Subsequent to that investigation, many stocks rebounded. Only a few have not shown an increase in run size after that rebound, i.e., primarily in the Whidbey Basin tributaries: Snohomish, Stilliguamish, and Skagit rivers (Ruff 2019).

On March 10, 1998, NMFS determined that listing of the Puget Sound/Strait of Georgia Chum Salmon ESU was not warranted based on trends in spawning escapement levels.



Source: WDFW 2019.

Figure 4.5-10. Skagit River Chum Salmon spawning escapement (1994-2018).

Sockeye Salmon

General Life History and Habitat Requirements

Sockeye Salmon typically spend two to three years in the marine environment before returning to freshwater to spawn and die, typically around age four. Throughout their range, nearly all Sockeye populations are "lacustrine" meaning their life cycle is dependent upon a period of juvenile rearing in a lake (Table 4.5-2). Riverine Sockeye (ocean-type) spawn in a river and migrate directly to the ocean after only a few months in freshwater. Spawning generally occurs in the late summer and fall (August to November). Spawning sites generally contain medium to small-sized gravel, with a limited amount of coarse sand.

Distribution, Abundance, and Demographics in the Skagit River Basin

A single population of Sockeye Salmon has been identified in the Skagit River basin. It spawns in the Baker River, and its status changed from critical in 1992 to healthy in 2002 (WDFW and WWTIT 2003). The population is native with cultured production. The cultured production includes fish produced on artificial spawning beaches, which are transported as fry to Baker Lake, and then transported as smolts to be released below lower Baker dam. A small number of riverine Sockeye are found in the mainstem Skagit River during monitoring surveys and occasionally in lower Bacon Creek.

Steelhead

General Life History and Habitat Requirements

O. mykiss (steelhead and Rainbow Trout) is considered by many to have the greatest diversity of life history patterns of any Pacific salmon species. The species can be 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; Quinn and Myers 2004; NMFS 2018). This varied life history spreads mortality risk over space and time, thereby dampening population fluctuations and increasing resiliency to environmental variability (Moore et al. 2014). Although the mechanisms leading to anadromy or residency are not well understood, they appear to reflect interactions among genetics, individual condition, and environmental influences (Kendall et al. 2015).

In the Skagit River basin, steelhead typically migrate to marine waters after spending two to three years in fresh water (NMFS 2012). They then generally reside in marine waters for two or three years prior to returning to their natal stream to spawn as four-, five-, or six-year-olds (Table 4.5-2). Unlike most Pacific salmon, steelhead are iteroparous, meaning they are capable of spawning more than once before they die. However, it is rare for steelhead to spawn more than twice before dying; most that do so are females. Steelhead adults typically spawn between December and June (Bell 1990; Busby et al. 1996).

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry. These two ecotypes are termed “stream-maturing” and “ocean-maturing.” Stream-maturing steelhead enter fresh water in a sexually immature condition and require from several months to a year to mature and spawn. These fish are often referred to as “summer-run” steelhead. Ocean maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. These fish are commonly referred to as “winter-run” steelhead. The majority of the steelhead in Puget Sound are winter-run, but summer-run steelhead are also present, usually in sub-basins of large river systems including the Skagit River (Busby et al. 1996; NMFS 2012; NMFS 2018).

Steelhead and Rainbow Trout prefer relatively small, fast flowing streams with a high proportion of riffles and pools (Barnhart 1991). Multi-threaded channels, islands, large wood, streamside vegetation, and interconnected floodplains help ensure reproductive success by providing and maintaining clean gravels and protecting incubating eggs from floods (NMFS 2018). Spawning areas are often associated with deep pools and abundant instream cover and incubating eggs require a relatively stable stream channel, adequate intragravel flow and dissolved oxygen, and adequate water depth above the redd. After emergence, steelhead fry form small schools and inhabit the margins of the stream. As they grow larger and more active, they slowly begin to disperse downstream. In their first year of life, most steelhead 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. Natural rearing of steelhead typically lasts two years prior to ocean migration, although some juveniles smolt after only one year and others may take up to three years.

Unlike most salmonids in Puget Sound, steelhead do not rear extensively in estuaries or nearshore habitats. Nevertheless, as steelhead migrate to the ocean as smolts, diverse channels with abundant wood and complex river deltas help protect them from predation, largely from marine mammals and birds (Simenstad et al. 1982; Gonor et al. 1988). Steelhead smolts typically migrate directly from natal freshwater streams and rivers to the ocean very rapidly, spending only a few days to a couple of weeks in Puget Sound. Despite their rapid migration into and through Puget Sound, recent research has revealed high mortality rates of steelhead during this life stage (Moore et al. 2010; Moore et al. 2015).

Steelhead oceanic migration patterns are largely unknown. Evidence from tagging and genetic studies indicates that Puget Sound Steelhead travel to the central North Pacific Ocean (Burgner et al. 1992; NMFS 2012), although these conclusions are based on a very limited number of recoveries in the ocean.

As described above, releases of hatchery steelhead into the Skagit River basin were discontinued in 2013, and the adults from these releases returned in the 2014-2015 winter season. The Skagit River basin has had hatchery-produced fish releases since the early 20th Century, with early collections of eggs from native runs from the Baker River, Day Creek, Grandy Creek, Illabot Creek, and Finney Creek during the early 1900s (Myers et al. 2015). The vast majority of the hatchery steelhead historically released into the Skagit system were winter hatchery steelhead.

Harvest can affect the overall abundance and productivity of steelhead populations. From the late 1970s to early 1990s, harvest rates on natural-origin Puget Sound Steelhead averaged between 10 percent and 40 percent, with some populations in central and south Puget Sound at over 60 percent. Harvest rates on natural-origin steelhead varied widely among watersheds but have declined since the 1970s and 1980s and are now stable and generally less than five percent, which is all incidental take (Myers et al. 2015).

Habitat factors also limit the overall abundance and productivity of steelhead populations. Although an assessment of limiting factors specific to steelhead in the Skagit River basin has not been conducted, NMFS (2018) identified 10 primary habitat pressures associated with the listing decision for Puget Sound Steelhead: (1) fish passage barriers at road crossings; (2) dams, including fish passage and flood control; (3) floodplain impairments, including agriculture; (4) residential, commercial, industrial development (including impervious runoff); (5) timber harvest management; (6) altered flows and water withdrawals; (7) ecological and genetic interactions between hatchery- and natural-origin fish; (8) harvest pressures (including selective harvest) on natural-origin fish; (9) juvenile mortality in estuary and marine waters of the Puget Sound; and (10) climate change. Previously, the five-year status review for Puget Sound Steelhead identified an additional nine limiting factors: destruction and modification of habitat, reduction in spatial structure, water temperatures, downstream gravel recruitment, reduced movement of LWD, gravel scour, bank erosion, sediment deposition, and shoreline modifications and hardening. The limiting factors most prevalent in the Skagit River system are further detailed in Section 4.5.3.2.

Distribution, Abundance, and Demographics in the Skagit River Basin

Myers et al. (2015) grouped the Puget Sound Steelhead distinct population segment (DPS) populations into three extant major population groups (MPG) containing a total of 32 DIP based on genetic, environmental, and life history characteristics. Populations can include summer steelhead only, winter steelhead only, or a combination of summer and winter run timing (e.g., winter-run, summer-run or summer/winter-run). The Skagit River contains four steelhead DIPs, as identified in Myers et al. (2015): (1) Skagit River Summer Run and Winter Run; (2) Nookachamps Creek Winter Run; (3) Sauk River Summer Run and Winter Run; and (4) Baker River Summer Run and Winter Run (Myers et al. 2015). According to Smith and Anderson (1921), steelhead were historically found in “considerable numbers” in the Skagit River up to the construction camp for the Project near Newhalem. At that time, they identified Goodell Creek as the farthest branch of the Skagit from the mouth that contained anadromous fish (NMFS 2012).

<u>Skagit River Winter Steelhead</u>

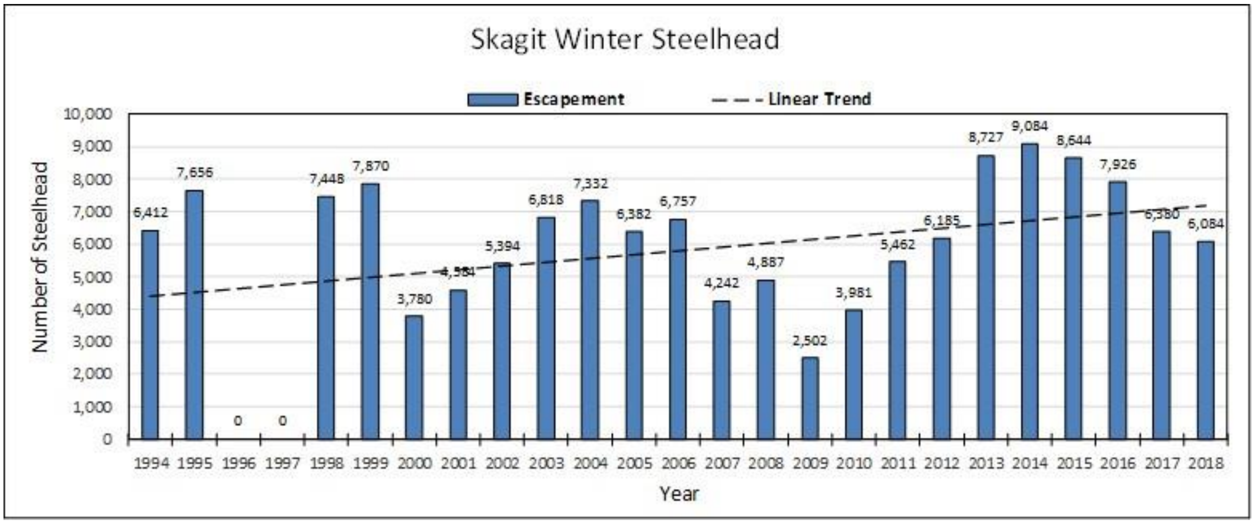
The Skagit River Winter Steelhead DIP currently spawns in the mainstem Skagit River between RM 22.5 and 94.1 and in Nookachamps, Alder, Diobsud, Mill, Grandy, Pressentin, Finney, Jackman. Rocky, O’Toole, Cumberland, Day, Anderson, Sorenson, Hansen, Illabot, Bacon, Rocky, Newhalem, Goodell, and Jones creeks (WDFW 2002, 2019). WDFW (2019) and WDFW (2002) also reported that winter steelhead spawn in the Sauk River and Cascade River, but these spawning areas are continuous with the mainstem Skagit River. Sauk River spawning occurs from its confluence with the Skagit River to RM 41, portions of the South Fork Sauk River, the Suiattle River, the White Chuck River, and a number of tributaries such as White Creek, Dan Creek, Murphy Creek, and Falls Creek. The spawning distribution in the Cascade River extends from the Skagit River to near the confluence with the Middle Fork Cascade River (WDFW 2019).

Skagit River Winter Steelhead enter the river beginning in November (Hard et al. 2007). Spawning occurs from March through June, with peak spawning in May. Fry emergence peaks in early August (WDFW 2004). Outmigration occurs primarily from late April through early June (WDFW 2004).

The majority of naturally-produced winter steelhead juveniles throughout their range reside in fresh water for two years prior to emigrating to marine habitats, with limited numbers emigrating as one- or three-year-old smolts (NMFS 2012).

Skagit River winter smolt outmigration occurs during the spring with peak densities typically in late April and early May, with outmigration trailing off in early June (Kinsel et al. 2008). Scott and Gill (2008) consider the relative risk of extinction for Skagit River Winter Steelhead to be low. An important factor in this conclusion is their relatively high abundance.

The geometric mean escapement of Skagit River Winter Steelhead for return years 1994 to 2018 was 6,020 fish (Figure 4.5-11). The geometric mean escapement for return years 2013 to 2018 was 7,715 fish.



Source: WDFW 2019.

Figure 4.5-11. Skagit River Winter Steelhead spawning escapement (1994-2018).

<u>Skagit River Summer Steelhead</u>

Although there is considerable information indicating that summer-run steelhead existed historically in the Skagit River tributaries, recent surveys suggest that the summer-run component is at a critically low level. Locations where summer-timed fish have been reported include Finney Creek, Day Creek, the Cascade River, the upper Sauk River, and the South Fork Sauk River. However, despite extensive surveys, the only location where summer-timed fish are currently known to spawn is from RMs 8.0 to 11.6 of Finney Creek. Summer steelhead enter Finney Creek in October and November, with spawning occurring primarily from February through March (Sauk-Suiattle Indian Tribe et al. 2018). Fry emergence peaks in early August (WDFW 2004). Outmigration timing is likely similar to the mainstem Skagit winter population, which occurs primarily from early April through early June (Kinsel et al. 2008).

Because there is no summer steelhead hatchery program and no allowable harvest of wild summer steelhead, harvest management of Skagit River steelhead targets winter-run fish. The viability of the summer steelhead population is unknown.

Bull Trout

General Life History and Habitat Requirements

In the Puget Sound region, Bull Trout are found in habitats ranging from headwater reaches in the upper portions of watersheds to lower mainstem and marine waters. According to USFWS (2015a), five core areas within the Bull Trout Coastal Recovery Unit have been identified. These include the Lower Skagit and Upper Skagit core areas in the Puget Sound region. These core areas support the most stable and abundant Bull Trout populations in the recovery unit. This section focuses primarily on the Lower Skagit core area population; the Upper Skagit core area population is described in Section 4.5.1.3 of this PAD.

Bull Trout populations found in the Skagit River and its tributaries downstream of the Gorge Development exhibit complex gradients within three life history types (resident, fluvial, anadromous)[28] (Lowery and Beauchamp 2015). Fluvial Bull Trout are apex predators in the basin and are known to exploit seasonally-available food resources (Lowery and Beauchamp 2015). In tributaries, they become piscivorous after age two and initially consume Coho Salmon or steelhead/Rainbow Trout fry. They also consume salmon eggs, salmon carcasses, and aquatic insects (Lowery and Beauchamp 2015).

Bull Trout spawning occurs in mid-September through mid- to late November as water temperatures decrease to below 9°C (McPhail and Murray 1979; Weaver and White 1985), with peak spawning occurring in October (Reiman and McIntyre 1993; Downen 2006). Bull Trout eggs have a relatively long incubation period, and fry emergence may occur more than 200 days after egg deposition (USFWS 2004).

After spawning, Bull Trout disperse downstream to overwintering and foraging areas during October through November (Connor et al. 2009). Overwintering and foraging habitat for fluvial populations includes larger pools and deep runs in the upper reaches of the mainstem Skagit River, but may also include the Sauk River (USFWS 2004), and estuarine/marine habitats. Post-spawning anadromous Bull Trout outmigrate to the estuary during February through April with peak movements in mid-March (Connor et al. 2009).

Habitat limiting factors for Bull Trout in the Lower Skagit Core Area (i.e., downstream of Diablo Dam, see Section 4.5.4, Figure 4.5-21 were identified as (1) legacy forest management, (2) flood control, (3) agriculture practices and residential development and urbanization, (4) climate change, and (5) fish passage (USFWS 2015b). A description of these potential limiting factors for Bull Trout in the Lower Skagit Core Area can be found in Section 4.5.3.3 of this PAD.

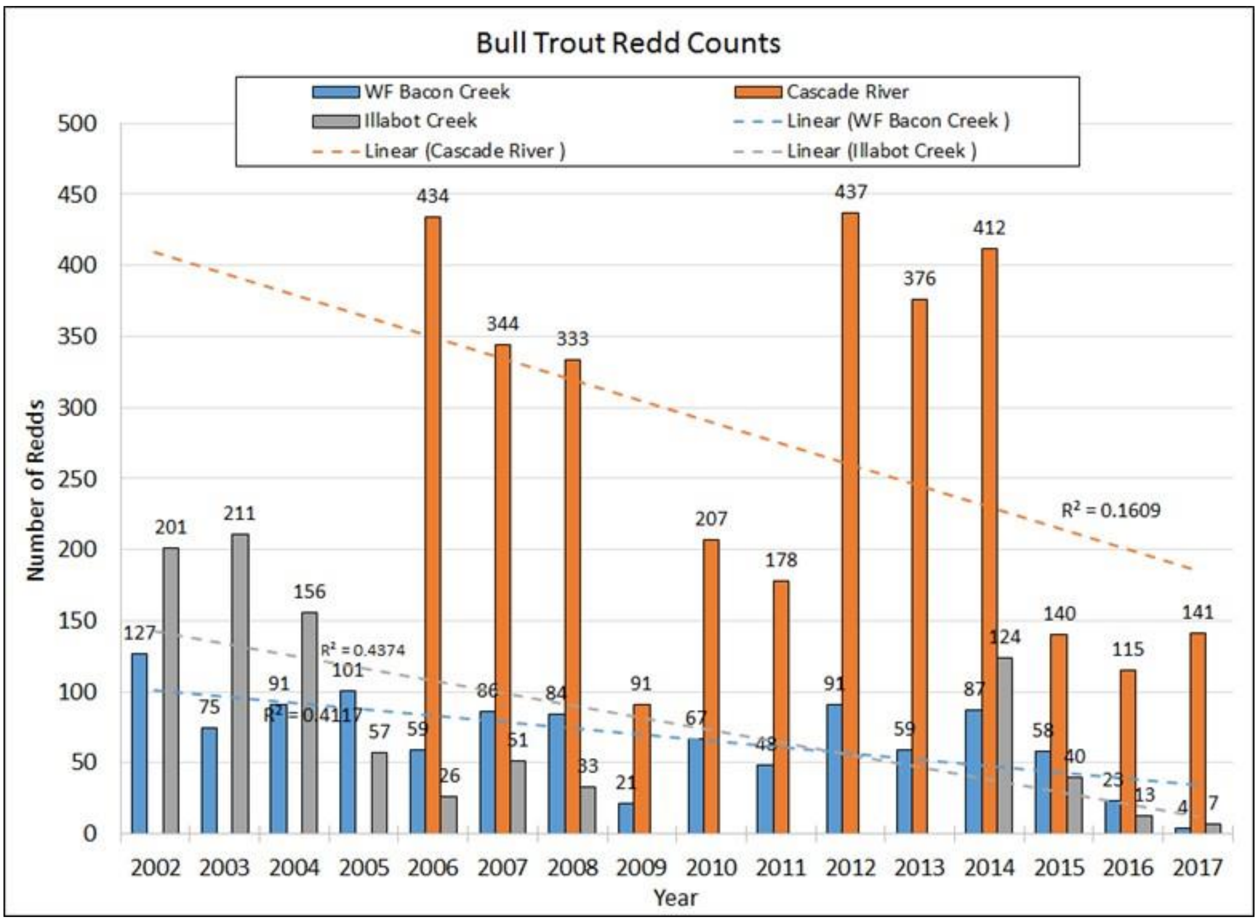
Distribution, Abundance, and Demographics in the Skagit River Basin downstream of the Gorge Development

Bull Trout are only known to spawn in the tributaries to the Skagit River between Gorge Powerhouse and the Sauk River confluence. Spawning has been documented in Illabot, Bacon, and Goodell creeks, and the Cascade River drainage (Lowery and Beauchamp 2015). Using genetic data, Smith (2010) determined that adult and sub-adult Bull Trout collected from the Skagit River immediately downstream of Gorge Powerhouse were primarily comprised of fish from Goodell Creek (38 percent) and Cascade River (35 percent), followed by smaller percentages of Illabot Creek (13 percent), Downey Creek (8 percent), Bacon Creek (4 percent), and Sauk River (2 percent) fish. None of the fish originated from the populations located above Gorge Dam. Analysis also showed that Bull Trout below Gorge Dam are significantly different genetically from Bull Trout in the upstream reservoirs (Smith 2010). It also is apparent that Bull Trout originating from some of these spawning tributaries exhibit anadromy. Genetic analysis of Bull Trout captured in the Skagit River estuary determined that approximately 12 percent originated from the Cascade River and 8 percent originated from Illabot Creek, with the remainder from the Sauk River system (M. Small, WDFW, unpublished data cited in Lowery and Beauchamp 2015).

[28] Resident Bull Trout spawn, rear, and live as adults generally in one headwater stream. Migratory Bull Trout spawn and rear in headwater streams and then, typically after one to four years, migrate downstream to larger rivers (fluvial) or lakes and reservoirs (adfluvial) where they grow to maturity. Anadromous Bull Trout remain in freshwater for one to three years before migrating to the marine environment.

Lowery (2009) reported that large fluvial Bull Trout adults are very abundant in the mainstem Skagit River between Gorge Powerhouse and the Sauk River confluence. Pilot level snorkel surveys conducted in February and March indicated that the reach contained 1,602 Bull Trout longer than 300 mm (95 percent confidence interval = 1,191-2,014; coefficient of variation = 13 percent). Lowery (2009) estimated that the tributary habitats upstream of the Sauk River confluence contained 179,265 Bull Trout between ages one and three.

Resource managers use spawning surveys to enumerate Bull Trout redds in Bacon, Illabot, and Goodell creeks, and within the Cascade River drainage. The redd survey data sets for Bacon, Illabot, and Cascade drainages extend over a fairly long period of time (various monitoring from 2002 to 2017). While the linear trends are relatively weak (indicated by low R^2 values), these data suggest the total number of Bull Trout redds in the index declined over the monitoring time period (Figure 4.5-12). A similar decline in Bull Trout redds was also observed in the South Fork Sauk River spawning survey index over the same time period (Fowler 2018). However, researchers have found index surveys have generally low power to detect adult Bull Trout spawner abundance trends (Howell and Sankovich 2012; Al-Chokhachy et al. 2005; Dunham et al. 2001; Jacobs et al. 2009; Maxell 1999).



Source: Fowler 2018.

Figure 4.5-12. Total yearly Bull Trout redd counts from index reaches within Skagit River tributaries upstream of the Sauk River confluence.

Coastal Cutthroat Trout

General Life History and Habitat Requirements

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, rarely over-winter at sea and do not usually make extensive ocean migrations (Table 4.5-2) (Johnson et al. 1999).

All Cutthroat Trout, regardless of their life history type, are spring spawners. Actual spawning time depends on latitude, altitude, water temperature, and flow conditions (Trotter 1991). As with all salmonids, substrate composition, cover, water depth, water velocity, and water quality are important habitat elements before and during spawning (Bjornn and Reiser 1991). In general, adult Coastal Cutthroat Trout spawn in low gradient riffles and in shallow pool tail-outs. The preferred spawning substrate is clean pea-sized to walnut-sized gravel (Trotter 1997). The volume of water in spawning streams seldom exceeds 10 cfs during the low flow period and most average less than 5 cfs (Johnston 1989; Trotter 1991). Coastal Cutthroat Trout have been known to spawn each year for more than six years (Johnson et al. 1999).

While rearing in freshwater, young sea-run Cutthroat Trout are opportunistic feeders. Fry feed on small invertebrates (Scott and Crossman 1973). As they increase in size, they begin to feed on larger aquatic and terrestrial insects, salmon eggs, and small fish.

Distribution, Abundance, and Demographics in the Skagit River Basin

Both resident and anadromous coastal Cutthroat Trout are found throughout the Skagit River basin. The anadromous life history form is present in the mainstem Skagit River and tributaries throughout the anadromous reaches of the system. The resident form is found in the Skagit River and its major tributaries; however, the species' distribution and abundance above Gorge Dam are not well documented and it is likely individuals above Gorge Dam are the result of historical fish stocking. Spawning occurs from January through mid-June and can occur throughout the watershed, primarily in small tributary streams (Figure 4.5-1). Survival after spawning and the number of times an anadromous Cutthroat Trout spawns during its lifetime are variable across its range. Most juveniles remain in freshwater for two to four years before smolting and migrating to saltwater, though the range extends from one to six years (Trotter 1989; Bjorn and Reiser1991;

Pacific Lamprey

General Life History and Habitat Requirements

In Washington, Pacific Lamprey are found in most large coastal river systems including the Skagit River and its major tributaries (Wydoski and Whitney 2003). Pacific Lamprey are anadromous. 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 located at the upstream end of riffles. Spawning takes place in spring (from April to July) when water temperatures are between 10 and 16°C.

Distribution and Abundance in the Skagit River Basin

Based on a review of existing literature, there is limited information describing the distribution and abundance of Pacific Lamprey in the Skagit River basin. However, Goodman et al. (2008) reported capturing Pacific Lamprey ammocoetes in tributaries of the Nooksack, Skagit, and Pilchuck (tributary to the lower Snohomish River) rivers in 2004. Hayes et al. (2013) also reported capturing River Lamprey and Western Brook Lamprey and generic "lamprey" as incidental catch in salmon smolt traps in systems around Puget Sound, including the Skagit River. In addition, Hayes et al. (2013) indicated that Pacific Lamprey ammocoetes have been identified in "upstream portions" of the Skagit River. Ostberg et al. (2018) reported detecting Pacific Lamprey environmental DNA (eDNA) in the Skagit River.

4.5.1.3 Resident Fish

As described in Section 4.5.1.1 of this PAD, geological analyses indicate that the upper Skagit River, upstream of the Diablo Dam site was physically separated from the remainder of the Skagit River until the last part of the Pleistocene. Prior to this time, it is thought that the upper Skagit was connected to the Fraser River system (Riedel et al. 2007). Genetic analyses of Bull Trout upstream and downstream of Gorge Dam support this hypothesis, as Bull Trout populations downstream of Gorge Dam are significantly genetically different from the upstream population (Smith 2010; Small et al. 2016).

Fish populations in the Project reservoirs are "freshwater resident", though instream migratory behavior between tributaries and the reservoirs has been observed. All three Skagit River Project reservoirs are inhabited by Rainbow Trout, Bull Trout, Dolly Varden, and Brook Trout. Redside Shiner is common in Ross Lake and present in Diablo and Gorge lakes. Cutthroat Trout are also present in Ross Lake (City Light 2012). Hybrid Dolly Varden/Bull Trout, and hybrid Dolly Varden/Brook Trout have also been documented in upper basin reservoirs and their tributaries on both the U.S. and Canadian side of the basin (Small et al. 2016; McPhail and Taylor 1995).

Bull Trout, Dolly Varden, and Rainbow Trout are considered native and indigenous upstream of Gorge Dam. Brook Trout are a non-native introduced species. While Redside Shiner are indigenous to the lower Skagit River basin, they are considered non-native in the Project reservoirs (Downen 2014). Likewise, Coastal Cutthroat Trout are indigenous to the Skagit River basin, but not upstream of Gorge Dam. Westslope Cutthroat Trout and Coastal Cutthroat Trout were stocked in areas upstream of Gorge Dam in the early 1900s. The life history, distribution, and demographics of native char (Bull Trout and Dolly Varden) and Rainbow Trout found in the Project vicinity upstream of Gorge Dam are presented below. Information on non-native Brook Trout, Cutthroat Trout, and Redside Shiner is presented in Section 4.5.1.4 of this PAD.

Native Char (Bull Trout and Dolly Varden)

General Life History and Habitat Requirements

The co-occurrence of Bull Trout and Dolly Varden in the upper Skagit River was first reported in the literature by McPhail and Taylor (1995). Bull Trout and Dolly Varden are present in all three Project reservoirs (Smith 2010; Small et al. 2016). However, due to their similar appearance, the majority of the fish population studies conducted in the Skagit River upstream of Gorge Dam do not differentiate these two species. As such, researchers often refer to them as "native char." Researchers have also documented the presence of Dolly Varden/Bull Trout and Dolly Varden/Brook Trout hybrids in the reservoirs through genetic analyses, further complicating assessments of these individual species in the field and laboratory (Smith 2010; Small et al. 2016).

Native char found upstream of Gorge Dam exhibit resident, adfluvial, and fluvial life history types (R2 Resource Consultants 2009; McPhail and Taylor 1995). Native char begin to migrate towards spawning areas in mid- to late September (City Light 2011). Pre-spawning adults have been observed to stage at the mouth of spawning tributaries and also move up to and hold in pools while they ripen (City Light 2011). Spawning occurs in late September through late November, peaking in October (City Light 2011). Acoustic-telemetry-tracking of native char in Ross Lake suggests that spawning migrations occur at night (R2 Resource Consultants 2009). This work and earlier radio-tracking studies (Nelson et al. 2004) have demonstrated that the majority of adfluvial native char spawn in the upper Skagit River in Canada, though several reservoir tributary streams (located in the United States) are also used (see distribution discussion below). Ongoing acoustic tracking studies indicate Bull Trout migrate to foraging areas in Ross Lake, including the mouths of Ruby, Lightning, and Big Beaver creeks where juvenile Rainbow Trout are known to concentrate (R2 Resource Consultants 2009; Eckmann 2015; City Light 2011). Adfluvial native char are also known to prey heavily on Redside Shiner in Ross Lake (Eckmann 2015).

Potential limiting factors identified by the UWFWS (2015b) for the Bull Trout core population upstream of Gorge Dam are recognized as (1) forest management practices; (2) recreational mining; (3) mining; (4) fish passage issues; and (5) hybridization. A further description of these potential limiting factors for Bull Trout in the Upper Skagit Core Area can be found in Section 4.5.3.3 of this PAD. Some of the limiting factors recognized for the lower Skagit Core Area are not risk factors recognized for the upper core population, specifically, agricultural practices, climate change, and flood control. The largely undeveloped state of the Skagit River basin above the gorge provides some measure of resiliency to these limiting factors affecting the lower Skagit River core population.

Distribution, Abundance, and Demographics in the Skagit River Basin

Historically, the upstream movement of native char populations in the lower Skagit River was likely naturally constrained by a series of natural upstream migration barriers in what is now Diablo Lake and the bypass reach (Smith 2010) (see Section 4.5.1.1 of this PAD). As a result, the upper Skagit River Bull Trout populations have remained geographically isolated and genetically different from those in the lower Skagit River (Smith 2010 Small et al. 2016). Genetic analysis of native char suggests that Bull Trout, Dolly Varden, and hybrids of these two species are present in all three lakes; with Bull Trout being most prevalent in Ross Lake and least prevalent in Gorge Lake (Anthony and Glesne 2014). Dolly Varden appear to be more prevalent than Bull Trout in Gorge Lake and in Diablo Lake (Smith 2010; Anthony and Glesne 2014; Small et al. 2016).

However, low sample size inhibits definitive distribution delineation between these two species. McPhail and Taylor (1995) found a mixture of Dolly Varden, Bull Trout and hybrids of these two species in the upper Skagit River basin in British Columbia. The authors suggest that the creation of Ross Lake allowed previously segregated Bull Trout and Dolly Varden trout populations to mix. Previously Dolly Varden are thought to have resided above natural barriers, while Bull Trout occurred downstream and in the mainstem Skagit River. The inundation of natural barriers allowed Bull Trout access to spawning habitat previously only occupied by Dolly Varden, facilitating hybridization.

Most of the large migratory native char that inhabit Ross Lake are thought to spawn and rear in at least six streams in the Skagit River drainage north of the U.S.-Canada border, including the mainstem Skagit, upper (East Fork) Skagit, Klesilkwa, Skaist, and Sumallo rivers, and Nepopekum Creek (McPhail and Taylor 1995). Bull Trout may also spawn and rear in McNaught, St. Alice, Maselpanik, and Snass creeks (McPhail and Taylor 1995). Within the U.S., native char have been documented in Ruby (including its tributaries, Canyon and Granite creeks), Panther, Lightning, Big Beaver, Little Beaver, Roland, Silver, Pierce, and Devils creeks (USFWS 2004; Downen 2014; R2 Resource Consultants 2009, USFS 2002). Lightning, Ruby, Big Beaver, and Little Beaver creeks are likely the primary native char spawning tributaries to Ross Lake outside of Canada. Thunder Creek is the only native char spawning tributary to Diablo Lake. Other tributaries to Diablo Lake that may be used by native char include Colonial and Rhode creeks; however, these two creeks have a limited amount of habitat (City Light 2012). Stetattle Creek is the only native char spawning tributary to Gorge Lake (Anthony and Glesne 2014).

The results of NPS's most recent fish surveys (for native char) in the Project reservoirs are summarized in Table 4.5-3 (Anthony and Glesne 2014).[29] Individual native char/Brook Trout hybrids have apparently been mistaken for pure native char during many prior field studies in the upper Skagit reservoirs (Anthony and Glesne 2014). Genetic samples taken from some of the "native char" collected during sampling (up to 30 percent) were found to be Dolly Varden/Brook Trout hybrids (Anthony and Glesne 2014). Small et al. (2016) also documented suspected Dolly Varden/Brook Trout hybrids in Diablo and Gorge lakes. Opportunistic genetic sampling has shown no evidence of hybridization between Bull Trout and Brook Trout in the Project reservoirs.

While some researchers in the upper Skagit River have not distinguished Bull Trout from Dolly Varden in the field, the results of recent genetic testing indicate that any native char over 300 mm found in the upper Skagit River drainage are likely Bull Trout (Smith 2010; Small et al. 2016; McPhail and Taylor 1995; City Light 2011). Any native char smaller than 300 mm may be Bull Trout, Dolly Varden or hybrids of some combination of Bull Trout, Dolly Varden, and Brook Trout.

[29] CPUE was reported in Anthony and Rawhouser 2017. However, because sample sites consisted of a single overnight gillnet set with gillnets of various sizes and were not consistent between years/reservoirs, the information is not included.

Table 4.5-3. Project reservoir native char gillnet sampling summary.

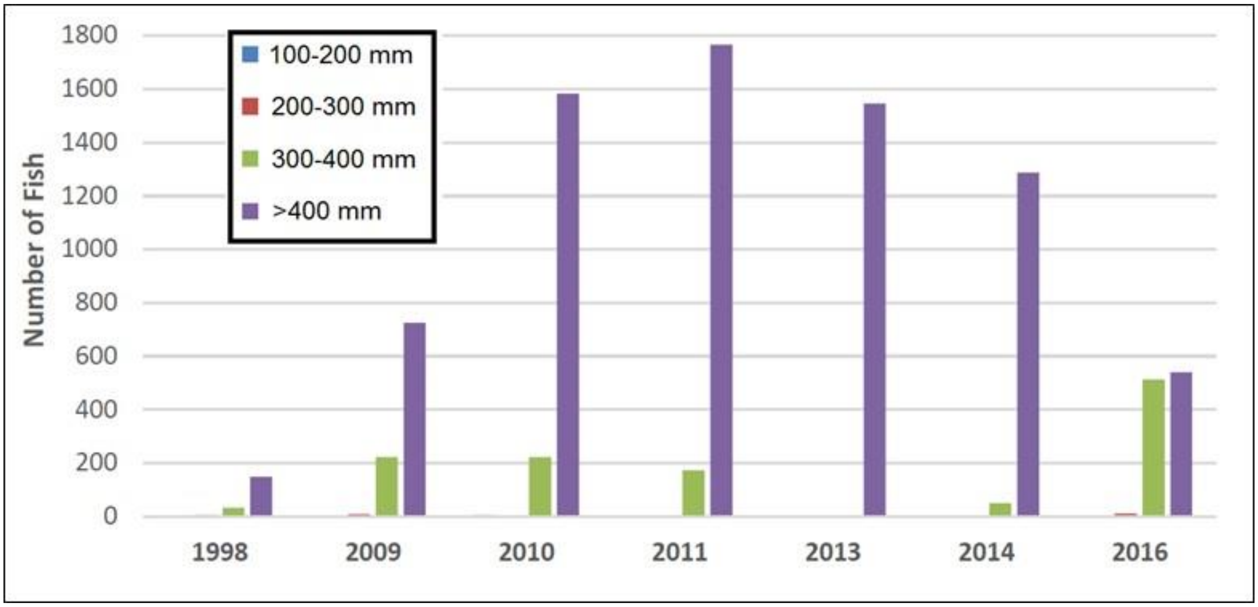
Reservoir	Year	Native Char Statistics				
		No. Caught	% total (n)	% total (weight)	Size Range (TL mm)	No. Sample Sites (% Occupied)
Ross	2006	24	15.2	51	186-760	6 (100%)
Ross	2007	54	12.5	52.4	120-813	not reported
Ross	2008	92	15.4	38.9	109-720	not reported
Ross	2012	53	17.4	62.5	196-759	13 (85%)
Diablo	2005	55	17.7	28.5	115-730	12 (67%)
Diablo	2010	14	3.6	14	163-505	12 (25%)
Gorge	2006	22	17.7	59.4	130-751	9 (78%)
Gorge	2011	29	28.4	28.8	122-319	10 (70%)

Source: Anthony and Glesne 2014.

Based on the results of snorkel counts conducted over a 22-mile reach divided into 14-contiguous sections in the upper Skagit River (upstream of Ross Lake), the number of native char appear to have increased substantially from 1998 to 2011 to several thousand fish (Triton 2017). Large Bull Trout are highly piscivorous and it is thought that the introduction of Redside Shiner into Ross Lake in the early 2000s has been a major factor contributing to the increase in Bull Trout abundance upstream of Ross Dam (Downen 2014; Anaka et al. 2012). In a diet study conducted by Eckmann (2015), Redside Shiner was the most common prey item (and only fish species) observed in the stomachs of adfluvial Bull Trout collected from Ross Lake. In addition to the introduction of Redside Shiner, a change in angling regulations in 1998 that no longer allowed the retention of Bull Trout may have also contributed to the increase in abundance.

After the initial large increase in Bull Trout counts in the upper Skagit River in response to this new prey base, native char (assumed to be Bull Trout) appear to have decreased somewhat from the 2011 peak, but native char counts have remained substantially above what they were prior to Redside Shiner introduction. Nearly 100 percent of the char observed during these counts were over 300 mm (Figure 4.5-13) and are assumed to be Bull Trout. Less than one percent of all native char counted in the index snorkel surveys were less than or equal to 300 mm (Anaka et al. 2012; Triton 2017).

Although the index snorkel survey is conducted over a 22-mile reach and a one-week period that minimizes double counting of fish, the counts should be viewed as a minimum number of fish in the population and not an estimate of total abundance (Anaka et al. 2012; Triton 2017). While total numbers of Bull Trout and Dolly Varden in Ross Lake and its tributaries are unknown, available data suggest that there are at least several thousand adult individuals of each species (Triton 2017).



Source: Triton 2017.

Figure 4.5-13. Size class of native char counted in a 22-mile index reach of the upper Skagit River upstream of Ross Lake (1998-2016).

There are no population estimates for native char in the Gorge and Diablo lake drainages, but based on the available data, abundance is lower than in the Ross Lake drainage, primarily due to limited habitat area.

Rainbow Trout

General Life History and Habitat Requirements

Resident Rainbow Trout populations are found in small, fast flowing streams, small to large rivers, and cool lakes. In the riverine environment, they prefer relatively complex habitat, consisting of an array of riffles and pools, submerged wood, boulders, undercut banks, and aquatic vegetation. Adults typically spawn during the spring and early summer. Rainbow Trout feed primarily on foods that are drifting on the surface, in the water column, or along the bottom of streams or lakes; examples are aquatic insects (Diptera, mayflies, stoneflies, and beetle larvae), amphipods, aquatic worms, and fish eggs. Occasionally they eat small fish. As they grow, the proportion of fish consumed increases in most populations. The individual fish then establish territories (microhabitats that contain feeding lanes and resting area), which they defend (Barnhart 1991).

Distribution, Abundance, and Demographics in the Skagit River Basin

Rainbow Trout are native to all three Project reservoirs and have been found to exhibit fluvial, adfluvial, and resident life histories upstream of Gorge Dam (Downen 2014; Anaka et al. 2012; Triton 2017). While their population status and distribution are poorly understood, resident fluvial Rainbow Trout are also present in the lower mainstem Skagit River below the Project dams, and in some tributaries to the mainstem below the dams (Pflug et al. 2013). Populations found in British Columbia and Ross Lake are highly migratory (Anaka et al. 2012).

In general, Rainbow Trout that inhabit Project reservoirs and reservoir tributaries rear for one to two years in larger streams or migrate from smaller streams to the lake in large numbers during their first summer (Downen 2014). They typically initiate immigration into the upper mainstem Skagit River from Ross Lake in late March and April to spawn (Anaka et al. 2012). Shortly after spawning, a large proportion (up to 85 percent in 1986) of the run returns to Ross Lake (Scott and Neuman 1988, as cited in Anaka et al. 2012). The remaining portion of the run remains in the river (Anaka et al. 2012). Over the summer, the Rainbow Trout that remain in the river gradually emigrate back to the reservoir (Anaka et al. 2012). By late October, very few trout remain in the upper Skagit River. Various environmental factors such as water level, water temperature, and availability of food also influence the rate of return to the reservoir (Anaka et al. 2012). Table 4.5-4 summarizes the most recent Rainbow Trout catch statistics for Ross, Diablo, and Gorge lakes (Anthony and Glesne 2014). Table 4.5-5 summarizes the spawner abundance estimates in Roland and Dry creeks.

Stetattle Creek is the only tributary to Gorge Lake, and Thunder and Colonial creeks are the only tributaries to Diablo Lake that are known to support regular spawning of Rainbow Trout (Downen 2014). In addition to Roland and Dry creeks, and the vast habitat in the upper Skagit River drainage, Rainbow Trout likely spawn and rear in all of the same tributaries to Ross Lake known to be used by native char (as described above).

The 1991 Settlement Agreement provided for development of a native Rainbow Trout broodstock program from Ross Lake to produce hatchery fish to supplement the Gorge and Diablo Lake Rainbow Trout fisheries (Downen 2014). WDFW began collecting broodstock annually from Roland and Dry creeks for the hatchery Rainbow Trout stocking program in 2002 as a component of City Light's resident fish mitigation program (see Section 4.5.6.1 of this PAD) (Downen 2014). Annual releases of upper Skagit hatchery Rainbow Trout ranged from 1,000 to 286,000 fish into Diablo Lake and 2,040 to 4,000 fish into Gorge Lake to enhance the popular recreational fishery (Downen 2014). This program is ongoing, as described in greater detail in Section 4.5.6 of this PAD).

Table 4.5-4. Project reservoir Rainbow Trout gillnet sampling summary.

Lake	Year	Rainbow Trout Catch Statistics					
		No. Caught	% total (n)	% total (weight)	Catch per Unit Effort (CPUE)	Size Range (TL mm)	No. Sample Sites (% Occupied)
Ross	2006	127	80.4	48.1	23.03	121-325	6 (100%)
Ross	2007	153	35.4	47.2	27.74	106-360	not reported
Ross	2008	311	52.1	56.3	7.89	109-410	not reported
Ross	2012	73	24	28.9	5.12	114-538	13 (62%)
Diablo	2005	161	51.9	47.4	14.6	109 -388	12 (100%)
Diablo	2010	170	43.8	56.5	30.7	99-347	12 (100%)
Gorge	2006	85	68.5	33.9	10.1	103-320	9 (100%)
Gorge	2011	53	52	52.5	9.5	112-322	10 (90%)

Source: Anthony and Glesne 2014.

Table 4.5-5. Annual Rainbow Trout spawner estimates in Roland and Dry creeks (2002-2012).

Year	Surveying Agency	Spawner Estimate		No. of Surveys per Year	
		Roland Creek	Dry Creek	Roland Creek	Dry Creek
2002	WDFW	485	175	6	N/A
2003	WDFW	276	330	8	7
2004	WDFW	501	330	8	8
2005	WDFW	854	247	8	7
2006	WDFW	285	103	8	8
2007	WDFW	412	158	8	6
2008	WDFW	479	170	8	6
2009	NPS	150	21	5	3
2010	NPS	96	24	7	7
2011	NPS	170	88	8	8
2012	NPS	41	25	8	8

Source: Anthony and Glesne 2014.

Resident Rainbow Trout can produce anadromous offspring (Kendall et al. 2015). As hatchery-origin introgression with wild steelhead is recognized as a factor of decline for wild steelhead (Araki et al. 2008), some concern has been raised with how this resident Rainbow Trout broodstock program could affect wild steelhead in the anadromous zone downstream of the Project reservoirs. In the event that resident trout derived from the program are spilled or otherwise conveyed into downstream waters, the potential for interbreeding cannot be discounted. To address this concern (amongst the more direct genetic introgression concerns of downstream hatchery steelhead production at Marblemount on wild steelhead), a series of genetic analyses was conducted with the three most common life-history forms of *O. mykiss* that are present in the Skagit: the hatchery and natural-origin steelhead, and the resident life history form (Pflug et al. 2013). Basic genetic characteristics were evaluated along with ancestry, hybridization level, and introgression among natural-origin adult and juvenile steelhead collections on a spatial level. Juvenile and adult ancestry data were used to identify where natural-spawning hatchery steelhead were reproducing successfully.[30]

[30] As summarized from Pflug et al. (2013), "caudal fin tissue was collected from hatchery and natural-origin steelhead adults and juveniles for use in extracting DNA. Similar samples were also taken from four populations of resident rainbow trout residing above migrational barriers located on Finney Creek, Clear Creek (Upper Sauk basin), Big Creek (Upper Suiattle River) and North Fork Cascade River. Additional resident rainbow trout samples were acquired from several tributaries or reservoirs located upstream of the Skagit River Hydroelectric project. Because of past stocking introductions into Ross reservoir by British Columbia (BC) an additional collection was derived from one out-of-basin population on the Blackwater River (BC) rainbow trout. DNA samples were also taken from the caudal fins of adult hatchery steelhead that had returned to the Marblemount hatchery in return years 2008-2010. Also, because of its proximity to the Skagit River, a final hatchery baseline was established from samples obtained from the Chilliwack River Hatchery in British Columbia. These samples were used to form DNA baselines for the 14 collection areas or types."

The specific objectives of the study were to analyze:

(1) Natural-origin steelhead adults and juveniles from mainstem reaches and tributaries within the Skagit River basin and address if steelhead within and among each reach and tributary are genetically homogeneous or differentiated;

(2) Steelhead from Marblemount Hatchery and Chilliwack Hatchery, B.C. to assess if they are differentiated from Skagit natural-origin steelhead;

(3) Resident Rainbow Trout from non anadromous areas within the Skagit River basin and compare them to natural-origin juvenile and adult steelhead;

(4) Natural-origin steelhead adults, juveniles, and resident Rainbow Trout within the same basin to determine if there has been downstream migration of the resident trout and mixing with the anadromous steelhead;

(5) Steelhead collected in the Sauk River from the 1980s and 2010s to determine if there has been a change in the genetic profile of natural-origin steelhead over time; and

(6) Steelhead harvested in fisheries to determine the stock composition of the catch of natural and hatchery-origin steelhead to determine if there is any evidence of genetic introgression.

Objective 3 most closely addressed the concerns of the Resident Rainbow broodstock program discussed in this section. Resident Rainbow Trout within the Skagit River basin from Baker River, Big Creek (tributary to the Suiattle River), Cascade River, Clear Creek (tributary to the Sauk River), and Finney Creek had pair-wise FST values that were all significantly different from zero with an average pairwise FST value of 0.2110 (range of 0.0931-0.3840 with exception of the temporal collections from Baker River, Big Creek and Finney Creek). A collection of resident Rainbow Trout from Blackwater River (British Columbia) was also analyzed and had an average pairwise FST value of 0.1557 (range of 0.0767-0.3183) when compared to Skagit basin Rainbow Trout collections. Pair-wise comparison of the Rainbow Trout collections from the upper Skagit River (Dry Creek, Diablo Lake, Ross Lake, Roland Creek, and Stetattle Creek) to each other revealed an average pairwise FST value of 0.0260 (range 0.0052-0.0457), and all pair-wise values were significantly different from zero. The only exception was the pairwise FST comparison between Roland and Dry Creek (0.0052; not significantly different from zero), and genotypic differentiation between Roland and Dry Creek that was not significantly different. All other genotypic differentiation pair-wise comparisons of upper Skagit Rainbow Trout collections were significantly different from each other.

Structure analysis was then conducted to assess the most likely number of distinct genetic groups among the 14 collections analyzed of the three life history types considered (i.e., hatchery steelhead, wild steelhead, and resident Rainbow Trout). Seven different genetic groups were identified. The upper Skagit (below Gorge) natural-origin steelhead and Baker River Rainbow Trout were in group 1; Rainbow Trout from the Cascade River, Big Creek, Clear Creek, Finney Creek, and Blackwater Creek were each identified to groups 2, 3, 4, 5, and 7 respectively; and the seven collections of resident Rainbow Trout from the upper Skagit River were all in group 6. Each of the collections had greater than 80 percent of their ancestry classified into one of the seven groups. The seven collections from the upper Skagit River were then analyzed separately to determine if there was any genetic structure that was not apparent when all 14 collections were analyzed. The analysis of the upper Skagit River Rainbow Trout collections identified three genetic groups: Diablo and Stetattle were in group 1; Dry Creek and Roland Creek were in group 2; and Ross Lake 2010 was in group 3. The other two collections had ancestry that was split into two different groups: Ross Lake 2006 groups 1 and 2; Ross Lake 2009 groups 2 and 3.

In summary, while there was genetic separation identified among the three upper Skagit River resident Rainbow Trout groups, they were all significantly different from natural-origin and hatchery-origin steelhead collections but not from the resident Rainbow Trout from Baker River. All comparisons of resident Rainbow Trout to the adult and juvenile steelhead collections from the same subwatershed were also significantly different. Using this information, Downen (2014) supported managing the Rainbow Trout in Ross, Diablo, and Gorge lakes as a single population.

4.5.1.4 Non-native Fish

Cutthroat Trout

While Coastal Cutthroat Trout are native throughout the lower Skagit River, they are not native upstream of Gorge Dam, and were stocked in the upper Skagit River drainage beginning in the early 1990s (Downen 2004). It is believed that both Westslope and Yellowstone Cutthroat Trout strains were stocked in the upper Skagit drainage in the United States (Downen 2014), and possibly other strains as historical records sometimes only list Cutthroat Trout stocking without identifying the strain (Downen 2004).

General Life History and Habitat Requirements

Cutthroat Trout exhibit a wide range in life history types from resident, fluvial, adfluvial, and anadromous (NRCS 2007). Cutthroat Trout upstream of Gorge Dam may exhibit all of these life history types except anadromy; however, little is known about the populations. Cutthroat Trout must be self-sustaining as no recent plantings have occurred. Cutthroat Trout spawn in tributaries, and can spawn from winter through spring. Their overall life history and habitat requirements are similar to Rainbow Trout.

Distribution, Abundance, and Demographics in the Skagit River Basin

Johnston (1989) reported the first recorded planting occurred in Big Beaver Creek in 1916 and included 47,000 Cutthroat Trout. There have been at least 170,000 Cutthroat Trout stocked in the Ross Lake drainage since that original planting (Johnston 1989). Stocked Cutthroat Trout became established in many lakes and stream reaches by the 1930s, including Thunder Creek, both above and below the current fish barrier (Downen 2014). Surveys of Devil's Creek (tributary to Ross Lake) reaches upstream of barriers found no other species except Cutthroat Trout (USFWS 2004). Triton (2008) reported that Cutthroat spawning populations are present in Ruby, Big Beaver, Little Beaver, and Lightning creeks. Anthony and Rawhouser (2017) reported Westslope Cutthroat Trout established a naturally reproducing population in the Ross Lake system, though the population size appears to be quite small and largely restricted to the Big Beaver Creek watershed. Records of Cutthroat Trout in the Canadian Skagit River watershed are somewhat rare and appear to be limited to incidental angler catches of adults in the lower Skagit River mainstem and Ross Lake (B.C. Ministry of Environment 2008).

Based on creel surveys and reservoir gillnet surveys, Cutthroat Trout appear to be the least abundant salmonid species upstream of Gorge Dam (Downen 2014; Anthony and Rawhouser

2017; Anthony and Glesne 2014). During the multi-year Ross Lake gillnet surveys reported by Anthony and Glesne (2014), Cutthroat Trout were only captured in 2008 (six individuals), which represented 1.0 percent of the total catch during the 2008 survey. Although available data are sparse, Cutthroat Trout populations upstream of Gorge Dam appear to be self-sustaining.

Redside Shiner

General Life History and Habitat Requirements

The Redside Shiner is a minnow (family Cyprinidae) native to the lower Skagit River. It inhabits runs and pools of small headwater streams, larger creeks, and small to medium rivers as well as lakes and ponds. It is usually found over mud or sand, often near vegetation. Fry feed on diatoms, copepods, ostracods, and other small planktonic and demersal crustaceans. As they become larger, their diet changes to terrestrial and aquatic insects, algae, mollusks, fish eggs (including their own), and small fishes. It is generally considered a baitfish or forage fish, its value being described as prey for other fish species. Additionally, Redside Shiner are consumed by piscivorous waterfowl such as mergansers and loons (Scott and Crossman 1973).

Distribution, Abundance, and Demographics in the Skagit River Basin

Historically, Redside Shiner were not present upstream of the gorge. However, the species was introduced into Ross Lake around 2000 and was found to be abundant there in 2004. The exact method of introduction is not known, but it is likely that it was due to their use as bait fish, a commonly recognized method of non-native fish introductions. During the summer months, Redside Shiner can be found in densities of hundreds per cubic meter in the shallow areas of the reservoir (Welch 2012). Based upon snorkel surveys conducted along the edges of Ross Lake in 2006, Downen (2014) estimated the Redside Shiner population in Ross Lake exceeded 1.2 million fish. In contrast to most lake populations of Redside Shiner, which tend to school around the shore during cooler months and head to the deep water during summer, the Ross Lake population appears to migrate to very deep water in the winter, returning to the nearshore habitat around May as temperatures increase (Wydoski and Whitney 2003). Recent catch statistics for Redside Shiner in the Project vicinity, as presented in Anthony and Glesne (2014), are shown in Table 4.5-6.

Table 4.5-6. Recent gill net catch statistics for Redside Shiner in the Project vicinity.

Lake	Year	No. Caught	Size Range (TL mm)	No. Sample Sites (% Occupied)
Ross	2006	4	98-109	6 (17%)
Ross	2007	224	90-118	not reported
Ross	2008	148	90-127	not reported
Ross	2012	167	93-127	13 (92%)
Diablo	2005	0	N/A	12 (0%)
Diablo	2010	137	85-123	12 (33%)
Gorge	2006	0	N/A	9 (0%)
Gorge	2011	0	N/A	10 (0%)

Source: Anthony and Glesne 2014.

The introduction of Redside Shiners in Ross Lake in the 2000s coincided with a dramatic increase in adult Bull Trout abundance and a reduction in the number of juvenile (10 to 20 centimeters [cm]) Rainbow Trout. Anaka et al. (2012) hypothesizes that this may mark the beginning of a shift in the ecology of the reservoir above Ross Dam. Resource managers are concerned that Redside Shiners could invade the Canadian Skagit River and compete with juvenile trout and Bull Trout for limited resources. However, ongoing reservoir monitoring by the USGS and City Light has yet to identify any negative effects on salmonid stocks (Welch 2012). In addition, the extremely large population size of Redside Shiners in Ross Lake makes control unfeasible (Downen in prep., as cited in Anthony and Glesne 2014).

In 2010, Redside Shiners were documented in Diablo Lake, and in 2019 they were observed in Gorge Lake, indicating that they are spreading to the downstream reservoirs through spill or entrainment through the turbines.

Brook Trout

General Life History and Habitat Requirements

Brook Trout are non-native to the western United States and were introduced into the upper Skagit River drainage in the early 1900s. Since then, they have become well established in Project reservoirs (Johnston 1989). Like Bull Trout and Dolly Varden, Brook Trout are a char in the genus *Salvelinus*, and as such, have similar life histories to those species. However, Brook Trout tend to mature earlier and at a smaller size than Bull Trout (Whitesel et al. 2001). Brook Trout also thrive in warmer water temperatures (Gunkel et al. 2002) and are known to out-compete Bull Trout in small stream environments (Gunkel et al. 2002). Brook Trout frequently hybridize with both Bull Trout and Dolly Varden.

Distribution, Abundance, and Demographics in the Skagit River Basin

Brook Trout have been documented in all three Project reservoirs and likely spawn and rear in numerous tributaries to these waterbodies. Derenne (2014) reported that Brook Trout from Pennsylvania were stocked throughout the sub-alpine lakes in the early 1900s and are now thriving in Hozomeen and Big Beaver creeks. Brook Trout have been regularly reported in creel surveys conducted in the Ross Lake drainage since the 1950s (Johnston 1989). According to USFWS (2004), Brook Trout is the dominant species in Hozomeen Creek, and the species has also been observed in Silver, Lightning, and Canyon creeks in the Ross Lake drainage. Downen (2004, 2014) reported that Brook Trout are abundant in Hozomeen, Big Beaver, and Thunder creeks and in the warm embayment along the northern shore of Diablo Lake.

While Brook Trout are well established in all three Project reservoirs, they appear to be most common in Diablo Lake and least common in Ross Lake (Table 4.5-7).[31] As described in the native char section above, genetic analyses have documented the presence of Dolly Varden/Brook Trout hybrids in the Project reservoirs (McPhail and Taylor 1995). McPhail and Taylor (1995) and later opportunistic sampling (Small et al. 2016; Smith 2010; Anthony and Glesne 2014) have shown no evidence of hybridization between Bull Trout and Brook Trout in the Project reservoirs; however,

[31] CPUE was reported in Anthony and Rawhouser 2017; however, because sample sites consisted of a single overnight gillnet set with gillnets of various sizes and not consistent between years/reservoirs, the information is not included.

the possibility of Bull Trout/Brook Trout hybridization cannot be eliminated based on the sampling conducted to date.

Table 4.5-7. Brook Trout gillnet sampling summary in Project reservoirs.

Lake	Year	Brook Trout Catch Statistics				
		No. Caught	% total (n)	% total (weight)	Size Range (TL mm)	No. Sample Sites (% Occupied)
Ross	2006	3	1.9	0.9	200-308	6 (33%)
Ross	2007	1	0.2	0.3	227	not reported
Ross	2008	40	6.7	4.3	120-351	not reported
Ross	2012	11	3.6	5.6	202-440	13 (54%)
Diablo	2005	94	30.3	24.1	116-290	12 (92%)
Diablo	2010	67	17.3	24.2	162-326	12 (75%)
Gorge	2006	17	13.7	6.7	158-290	9 (67%)
Gorge	2011	20	19.6	18.8	124-279	10 (50%)

Source: Anthony and Glesne 2014.

4.5.1.5 Aquatic Invasive Species

The Aquatic Invasive Species Unit (AISU) at WDFW monitors waterbodies throughout Washington to detect the occurrence of aquatic invasive species (AIS). The goal of the program is to prevent the spread of non-native aquatic nuisance species. Sampling conducted by AISU in lentic waterbodies includes plankton net tows, placement of artificial substrates that can be colonized by invasive species, visual shoreline observations, water quality measurements (including calcium levels), and collection of eDNA samples. The frequency of sampling at various sites is based on a risk assessment that includes over 17 variables such as ease of lake or reservoir access, numbers of boat ramps and docks, calcium levels, and local watershed land uses. AISU monitors for the following invasive species when conducting its surveys: zebra mussel (*Dreissena polymorpha*), quagga mussel (*D. bugensis*), Asian clam (*Corbicula fluminea*), Chinese mystery snail (*Bellamya chinensis*), New Zealand mudsnail (*Potamopyrgus antipodarum*), red swamp crayfish (*Procambarus clarkii*), virile crayfish (*Orconectes virilis*), rusty crayfish (*O. rusticus*), ringed crayfish (*O. neglectus*), and Sanborn's crayfish (*O. sanbornii*).

A number of sites are monitored by AISU in the Skagit River basin. In the vicinity of the Skagit River Project, sites include Colonial Creek Campground in Diablo Lake, NPS "Old Ramp South" in Ross Lake, and Winnebago Flats in Ross Lake. These sites have a low risk rating based on the AISU risk assessment and are visited one time per year. In Diablo Lake, annual sampling began in 2007. In Ross Lake, sampling began in 2019. AISU plans to continue sampling annually at the three sites identified above.

Aquatic invasive fish species that have been documented within the Project Boundary include Brook Trout and Redside Shiner[32] (found in all three reservoirs) (see Section 4.5.1.4 of this PAD).

[32] Redside Shiner are native to the lower Skagit River but were accidentally introduced to Ross Lake and are considered an invasive species upstream of Gorge Dam.

New Zealand mudsnails (*Potamopyrgus antipodarum)* were found in Skagit County (Indian Slough, west of Burlington) (USGS 2019a) and in Whatcom County (Lake Padden south of Bellingham) (WDFW 2019) in 2018, but they have not been documented in the upper Skagit River drainage. There are two nonnative crayfish species known to occur in Washington, the red swamp and virile crayfishes (Washington State Recreation and Conservation Office 2019). Neither of these species has been found in the Skagit River drainage. The Asian clam is established in the Baker River (USGS 2019b), a tributary to the Skagit River, but has not been detected in the Project vicinity. The following species, which AISU monitors for during its surveys, have not been detected in Washington: zebra or quagga mussels, Chinese mystery snails, and rusty, ringed, and Sanborn's crayfishes. Eurasian Watermilfoil, an aquatic macrophyte species of concern, occurs in the lower Skagit River drainage (USGS 2019c).

4.5.2 Aquatic Habitat

4.5.2.1 Ross Development

Ross Lake is the largest of the three Project reservoirs and supports important resident game fish species including Bull Trout, Dolly Varden, and Rainbow and Cutthroat Trout (see Section 4.5.1.3 and Figure 3.2-1 of this PAD). Physical characteristics of Ross Lake, including normal maximum water surface elevations and volume, are described in Section 3.4 of this PAD. Ross Lake’s water quality is discussed in Section 4.4. Ross Lake is generally a confined, steep-sided basin for much of its length, particularly from the dam to Lightning Creek, which enters from the east at approximately the mid-point of the reservoir. North of Lightning Creek, however, the reservoir bottom is more level in comparison to the area to the south.

Tributaries entering the U.S. portion of the upper Skagit River basin above Ross Dam provide extensive habitat for resident and adfluvial fish species spawning and rearing. About 950 linear miles of stream drainage exist within 33 tributaries (WDF 1975), of which about 243 miles are fish bearing and 39 miles are accessible to adfluvial fish. Approximately 381 sq. mi. of the Skagit River drainage are in British Columbia (USGS 2019), of which 137 miles of stream have been confirmed as fish bearing (Triton 2008). Triton (2008) reported a bedrock-controlled falls on the Skagit River just upstream of Snass Creek (i.e., in Canada) likely restricts the upstream migration of native char. Bull Trout surveys have primarily been limited to the portion of the mainstem Skagit River downstream of the Sumallo River (Murray and Gaboury 2005), located approximately 146 miles upstream of the U.S.-Canada border, but have also included a portion of the Sumallo River (Triton 2008).

Ross Lake is fed by several large, perennial streams on the U.S. side of the border. Ruby, Lightning, and Big Beaver creeks are the largest, followed by Little Beaver, Devils, Silver, Arctic, No Name, Hozomeen, Dry, Pierce, and Roland creeks. The Skagit River is the only outflow channel present. Physical characteristics and spawning habitat summaries of these major tributaries are summarized in City of Seattle (1973) and in City Light (1989a).

Important salmonid spawning areas within the Ross Lake watershed include the Skagit River above Ross Lake (i.e., Canadian waters), lower Lightning, Ruby, Canyon, Dry, and Roland creek, and the lake shore in the immediate vicinity of the mouths of Ruby, Lightning, and Roland creeks (Federal Power Commission Bureau of Power 1974; Downen 2014; Anaka et al. 2012; Triton 2017).

Lost Lake, a former kettle lake, is located within the Ross Lake drawdown zone approximately 0.75 miles west of the mouth of Lightning Creek. It is a deep, bowl-shaped depression that becomes exposed when the water surface elevation of Ross Lake drops below 1,505 feet, a condition which has occurred five times over the last 30 years (including 2018 and 2019). When exposed, Lost Lake is roughly circular, with a depth of approximately 90 feet and volume of approximately 4,800 acre-feet. NPS and other LPs have expressed concern that the isolation of Lost Lake could adversely affect fish trapped in Lost Lake during drawdown, primarily through exposure to elevated water temperatures and decreased dissolved oxygen concentrations. Meridian Environmental (2019) reviewed available information on Lost Lake from 2018 and 2019 and prepared a white paper to evaluate any potential effects on fish associated with the occasional isolation of this feature in the drawdown area. The findings from the white paper are summarized below.

- Review of three temperature profiles collected when Lost Lake was exposed in April 2018 shows that warming occurred to about 5 meters, while the remainder of the water column (20-30 meters) was less than 9°C. Temperatures in Lost Lake were colder than Ross Lake in 2019, and Lost Lake exhibited distinct thermal stratification. Differences in temperature in 2019 were likely due to wind effects; Ross Lake is exposed to a significant fetch that prevents thermal stratification, especially during the spring. There is little effect of wind energy on Lost Lake, which more easily stratifies. The influence of solar radiation on Lost Lake water temperatures is likely minor in contrast to the effects of air temperature.
- Dissolved oxygen levels in Lost Lake were high (approximately 11 mg/L) throughout the water column when the two profiles that were measured in 2018. Somewhat lower levels (average 8.5 mg/L) were measured in Lost Lake in 2019 in comparison to Ross Lake, despite lower temperatures in Lost Lake. As noted above, this may reflect wind/fetch effects i.e., the water column in Lost Lake is less well mixed.
- Available data indicate that temperature and dissolved oxygen levels in Lost Lake were unlikely to adversely affect fish within the lake over the short periods of exposure that have occurred to date (mid-March through April/early-May). Other water quality issues are unlikely; algal blooms were not apparent in either 2018 or 2019, suggesting that nutrient regimes and biological activity are similar in Lost and Ross lakes (both waterbodies can be classified as oligotrophic).
- Parent materials of soils in the area around Lost Lake are comprised of volcanic ash over glacial drift or alluvium, and soil types are considered well-drained with high or very high capacity to transmit water (USDA and NPS 2012). The walls of Lost Lake, particularly on the west side closest to Ross Lake, are likely similar to adjacent soil complexes/parent materials. Survey data collected during April 2018 indicate a high degree of hydraulic connectivity between Lost Lake and Ross Lake during drawdown conditions, i.e., surface elevations in the two waterbodies were very similar, and changes in Lost Lake mirrored those in Ross Lake.
- Delayed access to spawning areas for Rainbow Trout may occur if they become trapped in Lost Lake and drawdowns extend into May (Rainbow Trout spawn from May through June). Native char spawning would be unaffected. It is unknown whether there are changes in fish diets due to shifts in prey availability or changes in size distribution of fish isolated within Lost Lake. However, cold water temperatures observed during 2018 and 2019 would likely have reduced feeding rates relative to fish in Ross Lake.

4.5.2.2 Diablo Development

Although information describing aquatic habitat conditions in Diablo Lake is limited, a total of eight tributaries enter the lake with about 203 linear miles of stream drainage, about 63 miles of fish bearing stream, and a little over 11 miles of adfluvial fish habitat. The largest tributary within this watershed is Thunder Creek (17.8 miles long) (WDF 1975). Approximately 2.45 miles of Thunder Creek were made accessible to upstream movement of fish when the historical barrier was inundated by Diablo Lake. WDFW (1998) suggests that most salmonid spawning occurs in the Thunder Arm area, including Fisher Creek. Available habitat in the lower reach is considered "excellent" for salmonid spawning (WDFW 1998). Other minor tributaries including Colonial, Pyramid, Rhode, and Sourdough creeks probably provided little, if any, accessible habitat for native fish historically. Today only Thunder and Colonial creeks are known to support regular spawning of Rainbow Trout and native char (Downen 2006).

Water surface elevations in Diablo Lake fluctuate modestly on a diurnal cycle for power generation. Water residence time is low and the glacial waters that feed it are nutrient-poor, resulting in oligotrophic conditions with low chlorophyll *a* and limited zooplankton production. Thunder Creek contributes about 18 percent of the flow through Diablo, carrying substantial glacial till that results in reduced visibility and diminished light penetration in the reservoir. Discharge from Ross Lake strongly influences temperature profiles in Diablo Lake, which stratifies weakly, but does not develop a strong thermocline in summer and fall as Ross Lake does.

4.5.2.3 Gorge Development

Gorge Lake has approximately 11 miles of shoreline. Some limited Bull Trout spawning habitat is present in the upper end of the lake, within a mile of Diablo Dam (WDFW 1998), but it is uncertain if any Bull Trout actually spawn in this reach. The upper parts of the Gorge Lake between Diablo Dam and the Diablo Powerhouse may be dewatered when Gorge Lake is not at maximum water surface elevation (FERC 1995). There is very limited storage in Gorge Lake, and it is aptly named for the cliffs and talus slopes comprising much of the area bordering the reservoir. The few flat areas adjacent to the reservoir are developed, and a road runs along much of one side.

Six tributaries flow into the Gorge Lake watershed with about 54 miles of stream drainage, of which about 28 miles are considered fish bearing and 1.5 miles are accessible to adfluvial fish. Two of the tributaries, Gorge Creek and Stetattle Creek, are considered to have potential Bull Trout spawning habitat and Stetattle Creek is the largest. WDFW (1998) considers the lower 1.7 miles of Stetattle Creek and the mainstem Skagit River from the reservoir to Diablo Dam the primary spawning area for this population.

4.5.2.4 Gorge Bypass Reach

The 2.5-mile-long reach of the Skagit River extending from Gorge Dam to Gorge Powerhouse (bypass reach) flows through a steep, confined canyon that is characterized by bedrock and large boulder substrate. Aquatic habitat in the Gorge bypass reach is mainly limited by low flows (approximately 1.5 to 2.0 cfs during the low-flow period),[33] which do not provide a fully wetted channel (Envirosphere 1988).

Under existing conditions, flows of several hundred to over 20,000 cfs occur in the bypass reach during planned and unplanned spill events at Gorge Dam (Figure 4.5-14). These spill events are the result of either a load rejection, emergency shutdown, or the release of water during Gorge Powerhouse maintenance periods. During maintenance or emergency shutdown periods, water is routed through the Gorge bypass reach to maintain instream flow requirements in the Skagit River downstream from Newhalem. Between January 1, 1997 and April 16, 2019, there were 634 days (approximately 8 percent of the time) when Gorge Dam was spilling water into the bypass reach (Figure 4.5-14).

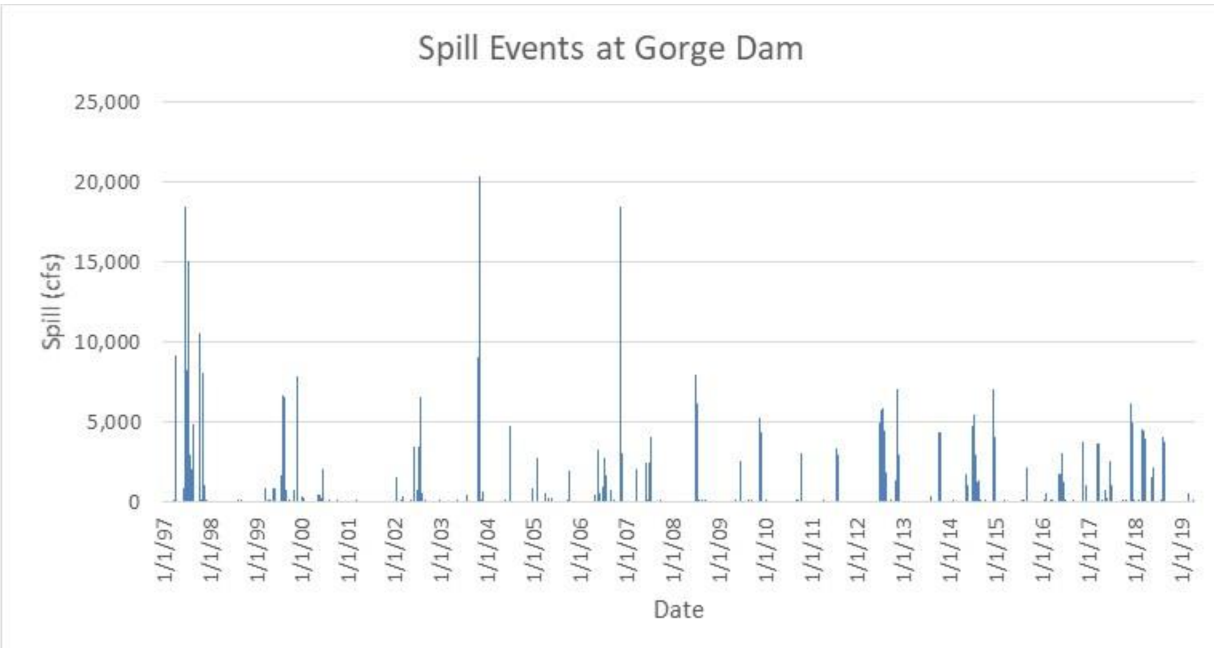


Figure 4.5-14. Documented spill events at Gorge Dam from January 1, 1997 – April 16, 2019.

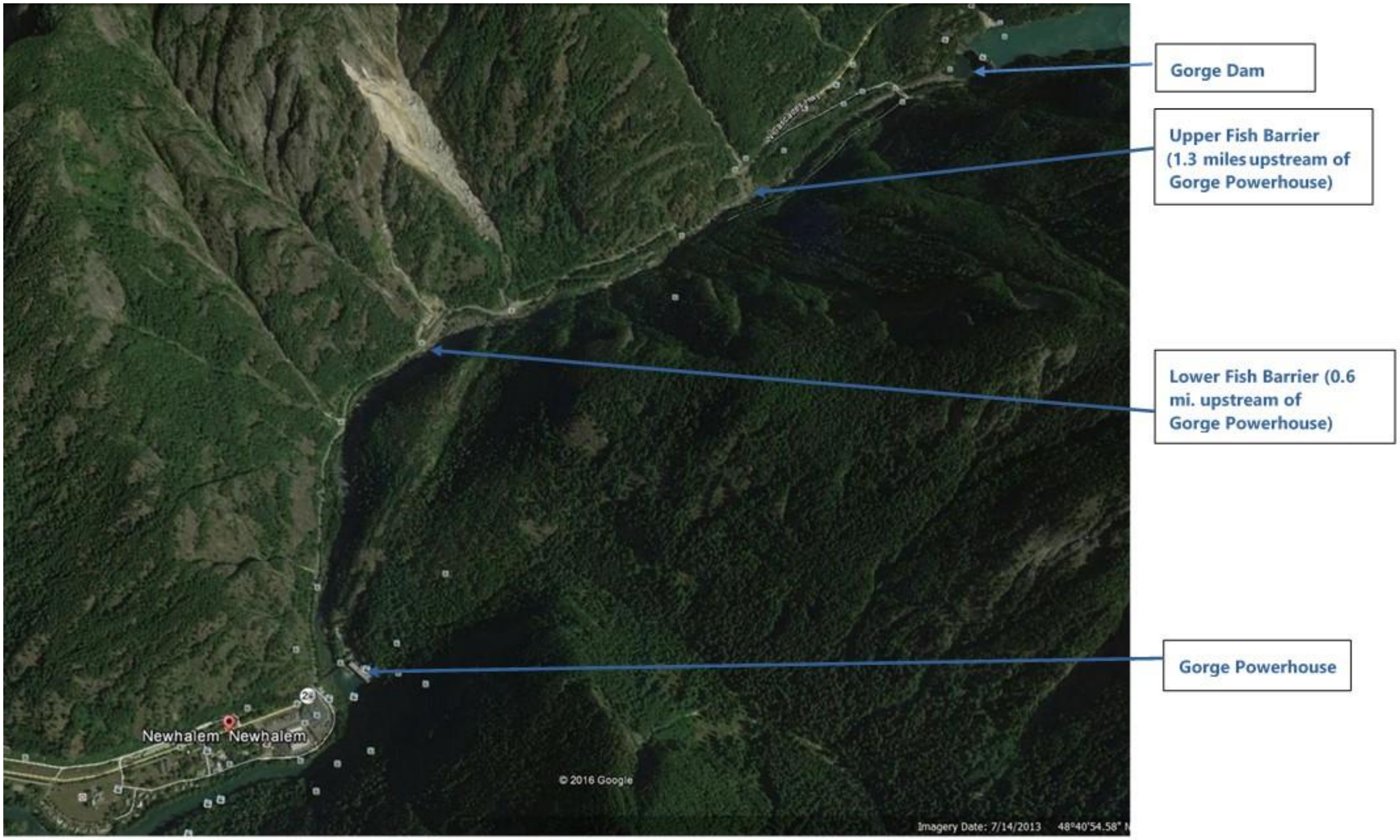
As described in Envirosphere (1989), the stream channel within the Gorge bypass reach is influenced by steep bedrock walls that confine the channel in various places, by large blocks of granite and gneiss, which have sheared from cliffs and fallen into the river channel, and by sediments that originate from tributary streams. These high-gradient sections are characterized by short boulder pools, cascades, and steep riffles. Substrates in these areas include large granite blocks (square-shaped boulders greater than 10 feet in diameter), large boulders, and cobbles. Above areas of channel confinement are aggraded sections, which have lower gradients and are characterized by riffles, deep runs, and elongated pools. Substrates in these areas are dominated by small boulders and large cobbles in runs and riffles and sand and gravels in pools. The width of the active channel ranges from 60 feet in narrow canyon sections to 230 feet along wide pools and adjacent to active alluvial bars. Envirosphere (1989) indicated that these channel conditions reflect extreme hydraulic conditions that occurred historically during frequent high flows. Similar

[33] Flows in the Gorge bypass reach are derived from seepage under Gorge Dam, groundwater accretions, and from four ephemeral (non-fish bearing) streams.

hydraulic conditions are presently encountered only during spill at Gorge Dam. These spill events likely still influence channel morphology in the bypass reach.

The lowermost section (about 0.6 miles in length) of the bypass reach is accessible to all fish species present in the mainstem Skagit River downstream of the Gorge Powerhouse (Connor 2016). However, a steep and narrow boulder falls and cascade about 0.6 miles upstream of the powerhouse constitutes a natural barrier to the upstream passage of salmon (Figures 4.5-15 and 4.5-16), and a similar feature is located farther upstream in the bypass reach, approximately 1.3 miles above the powerhouse (Figure 4.5-15) (Powers and Orsborn 1985). These features of the bypass reach are discussed in Section 4.5.1.1.

The entire bypass reach is bordered by SR 20, which in a few locations is less than 50 feet from the channel. Much of the timber on the slopes adjacent to the lower portion of the bypass reach burned in the Goodell wildfire in 2015.



Source: Connor 2016.

Figure 4.5-15. Locations of upstream fish passage barriers in the Gorge bypass reach.

Figure 4.5-16. Boulder falls and cascade 0.6 miles upstream of Gorge Powerhouse determined to be a barrier to the upstream migration of salmon.

4.5.2.5 Mainstem Skagit River to the Sauk River Confluence

The Skagit River below the bypass reach does not experience the extreme hydraulic forces evident in the highly confined Gorge section of the river. Consequently, the Skagit River below the powerhouse bears little resemblance to the bypass reach. The Skagit River below Gorge Powerhouse is fairly confined and broadens gradually from the confluence of Alma Creek to the Sauk River confluence.

Flows released from Gorge Powerhouse are typically between 2,000 to 7,000 cfs within the first mile downstream of Newhalem (FERC 2012). In this reach, bedload material is a mixture of gravel, cobbles and boulders or bedrock with few fine sediments present. About 100 feet downstream of the Gorge Powerhouse is a mid-channel depositional area built-up from gravel that has come out of the bypass reach (Figure 4.5-17). This habitat is used by Chinook, Pink, and riverine Sockeye Salmon and steelhead for spawning. Other fish, including Bull Trout, Chum Salmon, and Rainbow Trout use the area for foraging and rearing (City Light 2011).

Figure 4.5-17. Chinook, Pink, and riverine Sockeye Salmon and steelhead spawning habitat located immediately below the Gorge Powerhouse.

After the first mile below Gorge Powerhouse, the Skagit River flows through a low-gradient (less than 0.2 percent) narrow meandering valley bounded by steep topography. Connor and Pflug (2004) and NMFS (2012) report abundant spawning-sized gravel in this reach from bedload contributions from tributaries and glacial gravel deposits along the riverbanks. Substrate is dominated by small and large gravel and cobble located on gravel bars. NMFS (2012) reports little information on LWD levels in the Skagit River between Gorge Powerhouse and the Sauk River confluence, but suggests instream LWD levels are likely low. This is consistent with observations by City Light biologists of limited and highly mobile LWD jams in the river (Lowery 2019).

Few natural side channels exist in the Skagit River floodplain; City Light has created side channel habitat as required by the current Project license. Smith (2003) determined that creation of these off-channel habitats upstream of the Sauk River confluence has resulted in amounts of floodplain and off-channel habitats equivalent to or higher than historical levels and levels in other areas of the watershed. As described in Section 4.5.6.1 of this PAD, City Light has purchased and protected over 3,250 acres of high-quality habitat in the Skagit watershed as of 2019.

4.5.2.6 Skagit River Tributary Habitat Upstream of the Sauk River Confluence

Tributaries to the Skagit River in the Project vicinity between Gorge Powerhouse and the Sauk River confluence provide aquatic habitat for resident and anadromous fish. Major tributaries include Goodell, Newhalem, Bacon, Diobsud, and Illabot creeks and the Cascade River. These tributaries are outside the Project Boundary, except for small portions of those entering the Skagit River from the west, i.e., where the Project's transmission line crosses the streams near their mouths. Little information on tributary habitat conditions exists, with the exception of watershed analyses on the Jordan-Boulder system, which are tributaries to the Cascade River. Jordan and Boulder creeks were considered to have poor rearing and incubation habitat due to high sediment loads, low levels of LWD, and poor riparian conditions resulting from past timber harvest in the basins (NMFS 2012). SRSC and WDFW (2005) came to a similar conclusion when evaluating tributaries to the Skagit River upstream of the Sauk-Skagit confluence. They describe a subset of these tributaries – Corkindale Creek, Diobsud Creek, and Damnation Creek – in addition to the Jordan-Boulder system, as sediment impaired.

4.5.3 Rare, Threatened, and Endangered Aquatic Species

RTE aquatic species include those species that are listed, proposed for listing, or candidates for listing under the federal and/or Washington State ESA, species designated "Forest Service Sensitive;" and species designated by WDFW as "Sensitive." There are no fish species within the Project Boundary that are considered "Sensitive" by WDFW. The listed fish species present in the Skagit River basin and their listing dates are shown in Table 4.5-8.

Table 4.5-8. Federal ESA status and WDFW status for salmonids present in the Skagit River basin.

Species(ESU/DPS)	Federal ESA Status	Federal Listing Notices and Dates	WDFW Status
Puget Sound Chinook Salmon ESU	Threatened	Original Notice: 64 FR 14308 Date: 3/24/1999. Revised Notice: 70 FR 37160 Date: 6/28/2005	Candidate [1]
Puget Sound Steelhead DPS	Threatened	72 FR 26722 Date: 5/11/2007	-
Puget Sound Management Unit, Coastal-Puget Sound DPS	Threatened	64 FR 58910; Date: 11/1/1999	Candidate [1]
Puget Sound/Strait of Georgia Coho Salmon	-		Species of Concern

1 Puget Sound Chinook and Bull Trout are listed by WDFW as a Candidate species; the individual stocks are not classified.

4.5.3.1 Puget Sound Chinook Salmon

The following sections are summarized from Shared Strategy for Puget Sound (2007) and SRSC and WDFW (2005), unless otherwise cited.

Description of Listed Unit

Chinook Salmon in the Puget Sound Chinook Salmon ESU were listed as "threatened" under the ESA on March 24, 1999 (64 FR 14308, Table 4.5-8). The listing was reaffirmed on June 28, 2005 (70 FR 37160) following a status review by NMFS. The Puget Sound Chinook Salmon ESU includes all naturally spawned populations of Chinook Salmon from streams and rivers flowing into Puget Sound, the Strait of Juan Fuca from the Elwha River eastward, and 26 hatchery programs. The Puget Sound Salmon Recovery Plan (Shared Strategy for Puget Sound 2007) identifies six populations of the Puget Sound Chinook Salmon ESU as occurring within the Skagit River but only two in the Project vicinity: the Upper Cascade Spring Chinook and Upper Skagit Summer Chinook.

Chinook Population Status

The most recent five-year status review for Puget Sound Chinook was completed in 2014 and concluded that listing the species as "threatened" remained warranted. The status review stated that all Puget Sound Chinook Salmon populations were well below escapement abundance levels identified in the recovery plan as required to reach a low extinction risk. Chinook distribution, abundance, and demographics in the Skagit River basin are discussed in Section 4.5.1.2 of this PAD. Analyses of the abundance and distribution of Chinook Salmon in the mainstem Skagit River between the Sauk River confluence and Gorge Powerhouse demonstrate that the flow management measures being implemented by City Light have had a beneficial effect on the salmon population spawning in the reach (Connor and Pflug 2004).

Chinook Limiting Factors

As described in Section 4.5.1 of this PAD, the Skagit Chinook Recovery Plan (SRSC and WDFW 2005) identified limiting factors for Skagit River Chinook Salmon populations by life stage and life-history type. A summary of these potential limiting factors is presented below in Table 4.5-9).

Table 4.5-9. Potential limiting factors for Skagit River Chinook Salmon.

Potential Limiting Factor	Citation
Life stage recruitment (seeding levels)	SRSC and WDFW 2005[1]
Degraded riparian zones	SRSC and WDFW 2005[1]
Poaching	SRSC and WDFW 2005[1]
Dam operations	SRSC and WDFW 2005[1]
Sedimentation and mass wasting	SRSC and WDFW 2005[1]
Flooding	SRSC and WDFW 2005[1]
High water temperatures	SRSC and WDFW 2005[1]
Hydromodification	SRSC and WDFW 2005[1]
Water withdrawals	SRSC and WDFW 2005[1]
Loss of delta habitat and connectivity	SRSC and WDFW 2005[1]; NMFS 2016
Loss of pocket estuary habitat and connectivity	SRSC and WDFW 2005[1], NMFS 2016
Availability of prey fish species	SRSC and WDFW 2005[1]
Habitat destruction and degradation	SRSC and WDFW 2005[1]
High seas survival	SRSC and WDFW 2005[1]
Water quality impairment (pharmaceuticals, metals, polycyclic aromatic hydrocarbons, etc.)	NMFS 2016
Shoreline armoring (nearshore and instream)	NMFS 2016
Insufficient instream flows	NMFS 2016
Increase in impervious surfaces	NMFS 2016
Impaired floodplain connectivity and function	NMFS 2016
Fish passage barriers	NMFS 2016

1 Limiting factors specific to Skagit River Chinook Salmon.

Chinook Recovery Planning

The Puget Sound Technical Review Team identified 22 independent Chinook Salmon populations within five biogeographic regions (Nooksack, Hood Canal, South/Central, Whidbey, and Strait of Juan de Fuca) in the Puget Sound ESU (Ruckelshaus et al. 2006). The following recovery criteria were established (PSTRT 2005):

- The viability status of all populations.
- At least two to four populations in each of five biogeographic regions are viable.
- At least one population from each major genetic and life history group historically present within each of the five biogeographic regions is viable.
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario.
- Production of Chinook Salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with an ESU recovery.
- Populations that do not meet the criteria for all four viable salmon population (VSP) parameters are sustained to provide ecological functions and preserve options for ESU recovery.

The four VSP parameters are: abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). Abundance is the size of the population. Productivity refers to the intrinsic growth rate of a population, which can be expressed as the average annual percent increase or decrease in the size of a population over a period of time (e.g., 20 years). Spatial structure is the geographic distribution of fish at all life stages. Diversity addresses the variability in genetic, physiological, morphological, and life history and behavioral attributes.

The Skagit River includes six of the 22 independent Chinook Salmon populations in the Puget Sound ESU, and consequently will play an important role in its recovery. The six Skagit River populations (also referred to as stocks) are (Figure 4.5-2): Lower Skagit Fall Chinook Salmon; Upper Skagit Summer Chinook Salmon; Lower Sauk Summer Chinook Salmon; Upper Sauk Spring Chinook Salmon; Suiattle Spring Chinook Salmon; and Upper Cascade Spring Chinook Salmon. However, only Upper Skagit Summer Chinook and Upper Cascade Spring Chinook are present within the Project vicinity. Each of these populations are considered "demographically independent populations" that were identified using distinct trends in population abundance and variability, genetic separation, differences in life history characteristics and age structure, spatial and/or temporal separation of spawners, unique habitat and hydrological characteristics of a watershed, and catastrophic risk (e.g., drainage located near volcano) (PSTRT 2005). However, freshwater, estuarine, near-shore, and marine rearing life stages may overlap in both time and space.

Spatial, temporal, and genetic diversity is important for maintaining population viability because it reduces the risk that stochastic events such as landslides, droughts, or floods will adversely affect all components of a population, it allows populations to use a wider range of habitat patches, and genetic diversity allows the population to adapt to changing environmental conditions (McElhany et al. 2000). Diversity in the Skagit River Chinook Salmon populations is expressed primarily through a combination of their age of outmigration and age of return, but also through the spatial variability of habitat used by both juveniles and spawners. All of the populations have multiple life history strategies during outmigration (including fry, delta rearing, parr rearing, and yearling) and ages of return ranging from age two through five, plus infrequent age six fish. They therefore express a diverse life history that allows the population to persist in the event of relatively low survival in any particular location or period of the life cycle.

Many of the areas that contribute to spatial diversity of the populations, such as the river, delta, and near-shore environment, are considered degraded. The Skagit River estuary and tidal delta have been identified as one of the major bottlenecks affecting Chinook population productivity and abundance. The Summer and Fall Chinook Salmon populations that have a higher proportion of sub-yearling outmigrants that extensively use the delta region are more affected by degraded delta conditions. Rearing habitat availability in the middle Skagit River (RM 24.5 – RM 56.5) limits the number of Chinook Salmon parr that outmigrate from the Skagit watershed.

Spatial diversity for spawning is characterized by adult use of tributaries and off-channel habitat as well as the mainstem river. Degraded spawning habitat in lower tributary reaches have reduced spatial diversity for some populations. The lower Skagit Fall Chinook Salmon population appears to be the most severely affected by degraded tributary conditions and loss of off-channel habitat in the lower river.

Production goals for Puget Sound Chinook were developed for each of the six Chinook Salmon stocks present in the Skagit River basin. Goals were defined as those levels of abundance, productivity, connectivity, and diversity that would result from maintaining functioning habitat in its current condition and restoring degraded habitat at least to properly functioning conditions. Ecosystem Diagnosis and Treatment modeling was used to evaluate physical and biological inputs under current and historical conditions.

Because recovery must be robust to withstand naturally occurring fluctuations in marine survival, recovery goals were developed for average marine survival rates during the 1990s and for high marine survival rates, which existed during the 1970s and 1980s (Tables 4.5-10 and 4.5-11).

Table 4.5-10. Recovery goals for Skagit River Chinook Salmon at average marine survival rates during the 1990s.

	At Point of Maximum Surplus Production			At Point of Equilibrium	
Population	**Escapement**	**Resulting Recruitment**	**Recruits Per Spawner**	**Escapement**	**Resulting Recruitment**
Upper Cascade	290	870	3.0	1,160	1,160
Suiattle	160	450	2.8	610	610
Upper Sauk	750	2,270	3.0	3,030	3,030
Lower Skagit	3,900	11,900	3.0	15,800	15,800
Upper Skagit	5,380	20,600	3.8	26,000	26,000
Lower Sauk	1,400	4,200	3.0	5,580	5,580

Table 4.5-11. Recovery goals for Skagit River Chinook Salmon at high marine survival rates.

	At Point of Maximum Surplus Production			At Point of Equilibrium	
Population	**Escapement**	**Resulting Recruitment**	**Recruits Per Spawner**	**Escapement**	**Resulting Recruitment**
Upper Cascade	510	2,340	4.6	2,860	2,860
Suiattle	270	1,150	4.2	1,420	1,420
Upper Sauk	1,340	5,530	4.1	6,900	6,900
Lower Skagit	7,400	39,700	5.4	47,100	47,100
Upper Skagit	9,400	61,800	6.6	71,200	71,200
Lower Sauk	2,700	12,700	4.8	15,400	15,400

Annual harvest goals were identified in SRSC and WDFW (2005) as:

- Near-Term: 500 Spring Chinook; 20,000 Summer and Fall Chinook
- Longer-Term: 1,000 Spring Chinook; 30,000 Summer and Fall Chinook

4.5.3.2 Puget Sound Steelhead

The following sections are summarized from NMFS (2018) and Hard et al. (2015), unless otherwise cited.

Description of Listed Unit

The Puget Sound Steelhead DPS was listed as threatened on May 11, 2007 (72 FR 26722) (Table 4.5-8). The DPS includes all naturally spawned populations of steelhead originating below natural and manmade impassable barriers from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound, and the Strait of Georgia, plus six artificial propagation programs.

An MPG is considered a “recovery unit” based on aggregates within a DPS that share similar genetic, geographic, and/or habitat characteristics (McClure et al. 2003), and must be conserved to ensure the long-term viability of the species (Myers et al. 2015). Three MPGs have been identified in the Puget Sound Steelhead DPS: Central and South Puget Sound MPG; Hood Canal and Strait of Juan de Fuca MPG; and the North Cascades MPG. Two DIPs in the Northern Cascades MPG have been documented in the Project vicinity: (1) Skagit River Summer Run and Winter Run and (2) Sauk River Summer Run and Winter Run.

Myers et al. (2015) state, “The Skagit River Summer-Run and Winter-Run DIP includes all steelhead spawning in the mainstem Skagit River and its tributaries, excluding the Baker and Sauk rivers, from the mouth to the historical location of a series of cascades located near the Gorge Dam.” The only location where summer-timed fish are currently known to spawn is from RMs 8.0 to 11.6 of Finney Creek, which is located far downstream of the Project vicinity.

The Sauk River DIP was identified because of “the separation of Sauk River steelhead from those in the mainstem Skagit River and the distinctiveness of diversity components within the Sauk River basin itself (Myers et al. 2015).” “Samples from Sauk River steelhead were genetically similar to winter-run steelhead sampled from the mainstem Skagit River, especially those downstream of the Skagit/Sauk River confluence (Phelps et al. 1997, as cited in Myers et al. 2015).

Steelhead Population Status

The most recent five-year status review for Puget Sound Steelhead was completed in 2014 and concluded that listing the species as "threatened" remained warranted. The status review stated that most populations within the DPS were showing continued downward trends in estimated abundance.

The historical abundance of Puget Sound Steelhead is unknown, but commercial catch records and news articles from the early 1800s indicate that 409,000 to 930,000 adult steelhead returned each year to Puget Sound at the turn of the 19th century. Historical abundance of steelhead in the Skagit River is estimated to have reached 35,582 fish (Hard et al. 2015). Steelhead distribution, abundance, and demographics in the Skagit River basin are discussed in Section 4.5.1.2 of this PAD.

Steelhead Limiting Factors

Although an assessment of limiting factors specific to steelhead in the Skagit River basin has not been conducted, limiting factors for threatened Puget Sound steelhead have been evaluated by NMFS (2016, 2018). These potential limiting factors for Skagit River steelhead are listed in Table 4.5-12.

Table 4.5-12. Potential Skagit River steelhead limiting factors.

Potential Limiting Factor	Citation
Fish passage barriers at road crossings	NMFS 2018
Dams, including fish passage and flood control	NMFS 2018
Floodplain impairments, including agriculture	NMFS 2018
Residential, commercial, industrial development (including impervious runoff)	NMFS 2018
Timber harvest management	NMFS 2018
Altered flows and water withdrawals	NMFS 2018, NMFS 2016
Ecological and genetic interactions between hatchery and natural-origin fish	NMFS 2018, NMFS 2016
Juvenile mortality in estuary and marine waters of the Puget Sound	NMFS 2018
Harvest pressure (including selective harvest)	NMFS 2018
Climate change	NMFS 2018
Destruction and modification of habitat	NMFS 2016
Reduction in spatial structure	NMFS 2016
Water temperatures	NMFS 2016
Downstream gravel recruitment	NMFS 2016
Reduced movement of LWD	NMFS 2016
Gravel scour	NMFS 2016
Bank erosion	NMFS 2016
Sediment deposition	NMFS 2016
Shoreline modifications and hardening	NMFS 2016

Steelhead Recovery Planning

NMFS published a draft Recovery Plan for the Puget Sound Steelhead DPS on December 13, 2018 (NMFS 2018). For the Puget Sound Steelhead DPS to be considered viable, all three MPGs must be viable and there must be sufficient data available for NMFS to determine that each MPG is viable.

As excerpted from NMFS (2018), the Puget Sound Steelhead DPS can be delisted from federal protection under the ESA when NMFS determines that (1) the species has achieved a biological status consistent with recovery, meaning the best available information indicates it has sufficient abundance, population growth rate, population spatial structure, and diversity to indicate it has met the biological recovery goals and (2) factors that led to ESA listing have been reduced or eliminated to the point where federal protection under the ESA is no longer needed, and there is reasonable certainty that the relevant regulatory mechanisms are adequate to protect Puget Sound steelhead viability (see Section 4.2.2 of the Recovery Plan for DPS viability criteria).

NMFS' abundance and productivity planning targets for Puget Sound Steelhead populations were based on an estimate of 70 percent of historical abundance. The recovery target of 70 percent of historical abundance is based on an evaluation of stock-recruit productivity and capacity under properly functioning conditions based on the Ecosystem Diagnosis Treatment modeling in the Puget Sound Chinook Salmon Recovery Plan (Shared Strategy for Puget Sound 2007). The historical habitat estimates for the Skagit River, shown in Table 4.5-13, were initially generated from an intrinsic potential model of steelhead habitat (Hard et al. 2015), and subsequently modified based on feedback from steelhead biologists in a series of meetings throughout Puget Sound. Recovery goals based on productivity estimates are presented in Table 4.5-14. These recovery planning targets include a range of paired abundance and productivity (recruits per spawner) values in which the upper end of the abundance range, paired with a low productivity (replacement), is anchored to an estimate of 70 percent of historical abundance. Conversely, lower abundances consistent with recovery are paired with higher productivity values, because abundance can be lower when productivity is consistently higher, and abundance thresholds can be relatively high when productivity is consistently low.

Table 4.5-13. Historical abundance estimates for Puget Sound Steelhead DPS in the Skagit River basin, modified from estimates in Hard et al. (2007, 2015).

Demographically Independent Population	Habitat (kilometer [km])	Habitat Proportion	Historical Abundance	70% Historical Abundance
Skagit River	477	7.2%	31,582	22,108
Sauk River	213	3.2%	14,103	9,872
Nookachamps Creek	91	1.4%	6,025	4,218
Baker River	83	1.3%	5,495	3,847

Table 4.5-14. Current abundance and recovery goals for Puget Sound Steelhead in the Skagit River basin.[1]

North Cascades MPG Population	Current Abundance	Abundance Necessary to Meet Recovery Planning Target of 70 Percent of Historical Abundance	
		High Productivity (Recruit/Spawner = 2.3)	Low Productivity (Recruit/Spawner = 1.0)
Skagit River	8,278 [2]	6,600	22,100
Sauk River		3,000	9,900
Nookachamps Creek		1,300	4,200
Baker River	--[3]	1,100	3,800

1 Current abundance is the five-year average terminal run size (escapement + harvest) for return years 2012 – 2016, unless otherwise noted. It is suspected that the methods overestimated the historical steelhead abundance of populations composed of many small independent streams relative to those in larger rivers.
2 Combined abundance estimate for Skagit River, Sauk River, and Nookachamps Creek populations.
3 No current abundance data were available for the Baker River.

4.5.3.3 Coastal-Puget Sound Bull Trout

The following sections are summarized from USFWS (2015a and 2015b) unless otherwise cited.

Description of Listed Unit

Prior to the November 1, 1999 listing of Bull Trout within the coterminous United States, initial analysis divided Bull Trout into five DPSs (Columbia River, Klamath River, Jarbidge River, Saint Mary-Belly River, and Coastal-Puget Sound). The 1999 listing merged the five separate DPSs into one DPS of Bull Trout within the coterminous United States by including the Coastal-Puget Sound populations (Olympic Peninsula and Puget Sound regions) and Saint Mary-Belly River populations (east of the Continental divide in Montana) with previous listings of three separate DPSs of Bull Trout in the Columbia River, Klamath River, and Jarbidge River basins (63 FR 31647, June 10, 1998; 64 FR 17110, April 8, 1999). All Bull Trout in the Skagit River basin within the United States are identified as threatened under this listing.

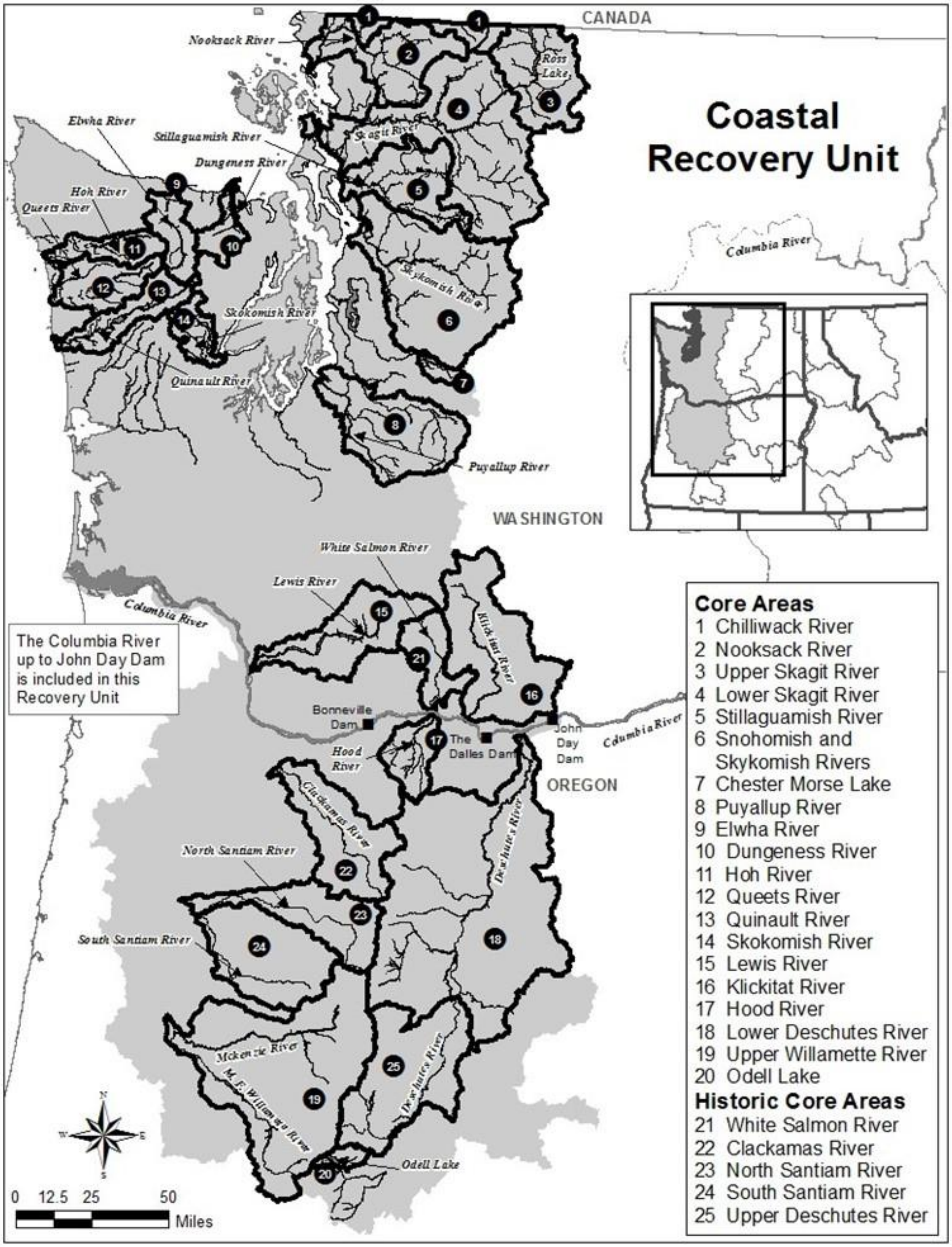
Bull Trout Population Status

The most recent five-year status review for Bull Trout was completed on April 8, 2008, and concluded that listing the species as "threatened" remained warranted range-wide in the coterminous United States. Based on this status review and the most recent USFWS recovery report to Congress, USFWS reported that Bull Trout were generally "stable" overall range-wide (species status neither improved nor declined during the reporting year), with some core area populations decreasing, some stable, and some increasing.

Bull Trout in the Skagit River basin, downstream of Gorge Dam, are part of the Coastal Recovery Unit (Figure 4.5-18), and Bull Trout in the upper Skagit River, upstream of Gorge Dam (within the United States) form the Upper Skagit River Core Area. Core Area populations include Big Beaver, Little Beaver, Lightning, Panther, Pierce, Ruby, Silver, Thunder, and Stetattle creeks in the United States; and the Skagit, East Fork Skagit, Klesilkwa, Skaist, and Sumallo rivers, and Nepopekum Creek populations in British Columbia. Bull Trout downstream in the rest of the

Skagit River basin form the Lower Skagit River Core Area; defined populations in the Project vicinity upstream of the Sauk River confluence are Bacon, Goodell, Illabot, and Newhalem creeks, and the Cascade and South Fork Cascade river populations.

The lower and upper Skagit River core areas are part of the 25 core areas included in the Coastal Recovery Unit. These two core areas are identified by USFWS as only two of five Bull Trout strongholds in the entire Coastal Recovery Unit. USFWS (2015a) determined the two Skagit River core areas likely contain two of the most robust Bull Trout populations with some of the most intact habitat within this recovery unit.



Source: USFWS 2015b.

Figure 4.5-18. Coastal Recovery Unit (Core Areas) for Bull Trout.

Bull Trout Limiting Factors

Habitat limiting factors in terms of "primary threats" were identified by USFWS (2015b) for the Coastal Recovery Unit core areas. Primary threats identified for the Lower and Upper Skagit River core areas include:

Lower Skagit River Core Area Threats

- Legacy Forest Management – associated sediment impacts, particularly from forest roads, have led to habitat degradation within key spawning and rearing basins (i.e., Sauk and Suiattle rivers) in the core area.
- Flood Control – flood and erosion control associated with agricultural practices, transportation corridors, residential development, and urbanization continues to result in poor structural complexity within lower river foraging, migration, and overwintering habitats (e.g., Skagit and lower Sauk rivers) key to the persistence of the anadromous life history form.
- Agriculture Practices and Residential Development and Urbanization – related activities have resulted in sediment and temperature impairment in major tributaries to the lower Skagit River and possibly upper Sauk River.
- Climate Change – increasing variability in flows (higher peak and lower base flows) are anticipated to significantly impact both spatial and life history diversity of Bull Trout within the core area.
- Fish Passage Issues – upstream and downstream connectivity at hydropower facilities (Baker River hydropower project) is directly tied to active fish passage measures under FERC agreements.

Upper Skagit River Core Area Threats

- Forest Management – legacy and ongoing degradation of habitat and water quality in spawning and rearing tributaries outside of designated protected areas; coordinate with British Columbia.
- Recreational Mining – activities impact spawning and rearing tributary habitats.
- Mining – legacy impacts from Silver Daisy Mine in upper Skagit River, potential contaminants and downstream impacts associated with proposed Imperial Metals Giant Copper mine in upper Skagit River and Ross Lake, legacy and current impacts from mining in Ruby Creek watershed; coordinate with British Columbia.
- Fish Passage Issues – upstream and downstream connectivity at hydropower facilities (Skagit River Project) is currently not tied to any measures under the current Project license. Recent genetic analyses indicate that the isolated local populations in both Gorge and Diablo reservoirs should both be grouped with the upper Skagit River local populations (Ross Lake populations).
- Hybridization – increasing risk of Brook Trout hybridization due to population expansion and increase in fish size as a result of Redside Shiner introduction; coordinate with British Columbia.

Bull Trout Recovery Plan

Two core areas within the Coastal Recovery Unit (Chilliwack River and Upper Skagit River) are transboundary, and USFWS determined their boundaries should extend into British Columbia from a functional standpoint. Recovery targets are based on cooperation with Canada and consider populations present in Canada. The Coastal Recovery Unit Implementation Plan for Bull Trout (USFWS 2015b) describes recovery and conservation recommendations for the Upper and Lower Skagit River core areas as described below. While all recommended actions related to the Upper Skagit Core Area are presented below, only those potentially applicable to the Project vicinity upstream of the Sauk River are described in this section for the Lower Skagit Core Area. Of note is that USFWS (2015b) indicated a number of the recovery actions and conservation recommendations identified for the Coastal Recovery Unit are currently being implemented as conditions to the Incidental Take Statements issued as part of Biological Opinions. For example, City Light is implementing ongoing conservation land acquisitions, habitat restoration projects, and population monitoring for Bull Trout recovery in the Skagit River watershed.

Lower Skagit River Core Area Recommended Actions

- Reduce stream channel degradation and increase channel complexity.
- Practice non-intrusive flood control and flood repair activities.
- Restore and protect riparian areas.
- Maintain and/or restore adequate instream flows.
- Implement adequate emergency measures to address climate change impacts such as greater variability in seasonal flows.
- Develop and implement restoration projects to minimize climate change impacts on flows.
- Continue ongoing population monitoring efforts within the basin.
- Refine angling regulations as appropriate. Periodically review harvest management and make recommendations for change as needed.
- Implement all recovery actions identified in Skagit Chinook Recovery Plan to further improve and/or maintain suitable habitat conditions for Bull Trout and their freshwater prey base in the core area.
- Monitor recreational mining activities and adjust regulations to prevent or minimize impacts on Bull Trout habitat.

Upper Skagit River Core Area Recommended Actions

- Provide adequate protection of spawning and rearing streams.
- Prevent or reduce impacts from small-scale recreational placer mining activities.
- Address heavy metal contaminant exposure from Silver Daisy Mine in British Columbia.
- Prevent downstream contamination from the proposed Giant Copper Mine development in the upper Skagit River.
- Address legacy effects from industrial gold mining in Ruby Creek. Tailings at the abandoned Azurite Gold Mine in the upper Skagit were found to possess toxic levels of copper, lead, and arsenic. These mine tailings drain into Bull Trout spawning and rearing areas within Mill Creek, Slate Creek, and Canyon Creek. Areas immediately below mine tailings were found to have reduced invertebrate diversity and waste rock dump was noted as having potential for catastrophic erosion.

- Ensure appropriate level of population connectivity in the Upper Skagit River core area.
- Develop and implement Brook Trout removal/suppression strategy.
- Evaluate the role and necessity of the local populations within Gorge and Diablo lakes to the long-term persistence of Bull Trout in the core area.
- Continue ongoing population monitoring efforts within the basin.
- Monitor level of hybridization with Brook Trout and adjust removal/suppression strategy accordingly.
- Periodically monitor Redside Shiner impact to ecosystem.

4.5.4 Federally-Designated Critical Habitat

4.5.4.1 Endangered Species Act – Designated Critical Habitat

Critical habitat areas are those that contain the physical and biological features (PBF) essential to the conservation of the species, and which may require special management considerations or protections. Critical habitat has been designated for Puget Sound Chinook Salmon, Puget Sound Steelhead, and Coastal-Puget Sound Bull Trout.

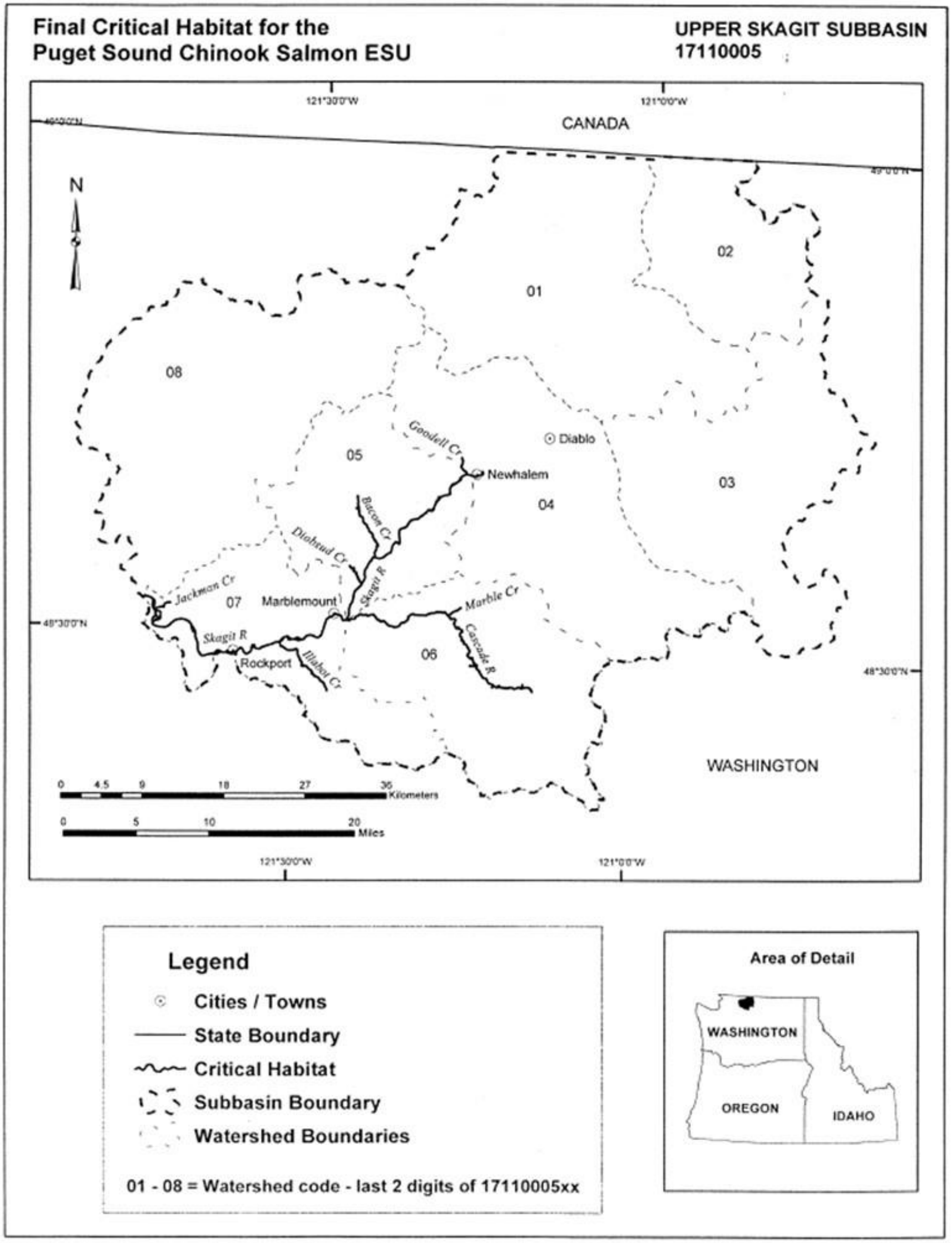
Puget Sound Chinook Salmon

Critical habitat for the Puget Sound Chinook Salmon ESU was designated by NMFS on September 2, 2005 (70 FR 52630). All of the mainstem Skagit River up to Gorge Powerhouse is designated as critical habitat, as well as portions of tributaries draining to the Skagit River (Figure 4.5-19). PBFs for Puget Sound Chinook Salmon critical habitat are described below.

Salmon/steelhead PBF 1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.

Salmon/steelhead PBF 2. 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.

Salmon/steelhead PBF 3. 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.

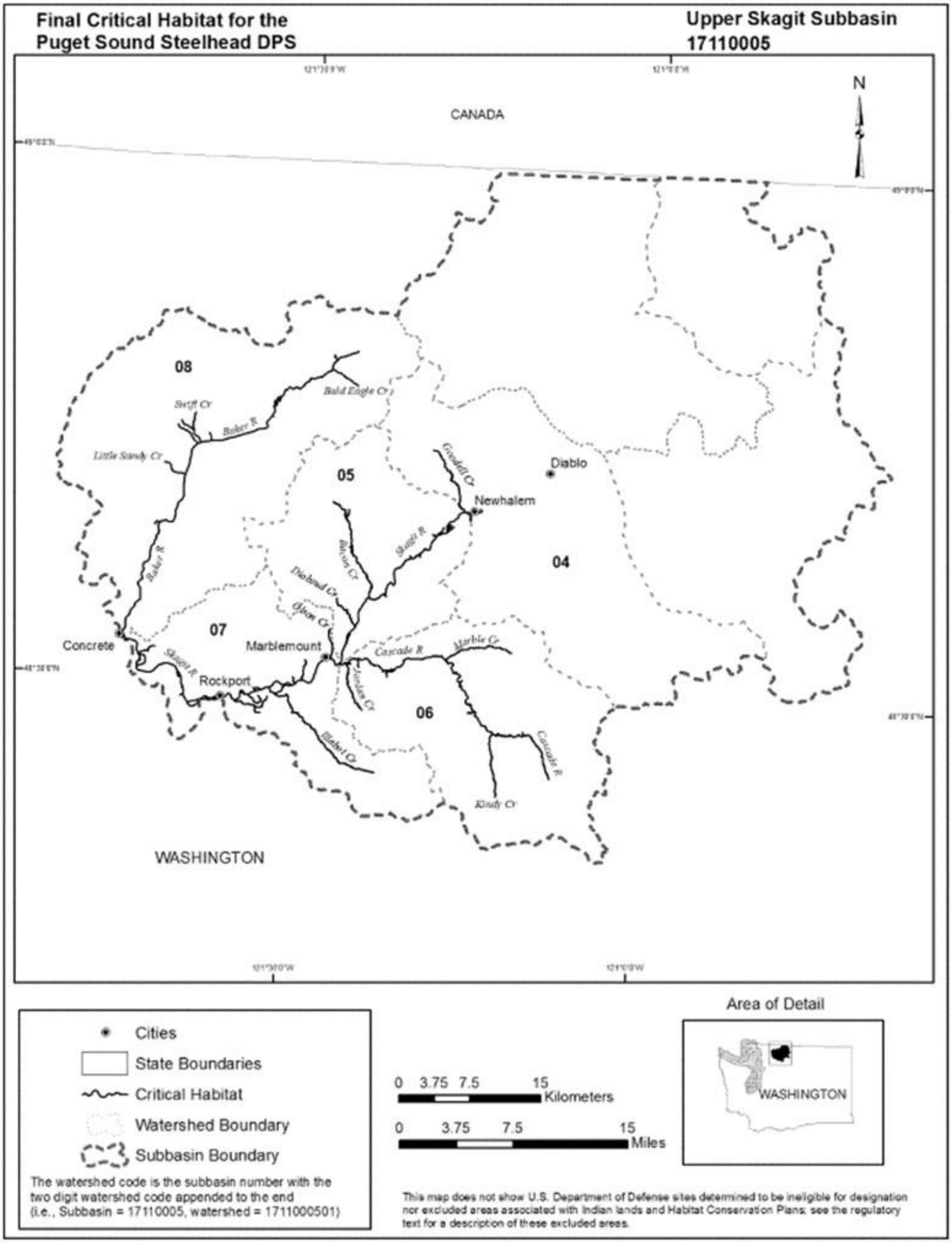


Source: 70 FR 52630.

Figure 4.5-19. Critical habitat for the Puget Sound Chinook Salmon ESU: Upper Skagit Subbasin.

Puget Sound Steelhead

Critical habitat for the Puget Sound Steelhead DPS was designated by NMFS on February 24, 2016 (81 FR 52630). All of the mainstem Skagit River up to Gorge Powerhouse is designated as critical habitat, as well as portions of tributaries draining to the Skagit River, including Baker River (Figure 4.5-20). PBFs for Puget Sound Steelhead critical habitat parameters are the same as those listed above for Chinook Salmon.



Source: 81 FR 52630.

Figure 4.5-20. Critical habitat for the Puget Sound Steelhead DPS: Upper Skagit Subbasin.

Coastal-Puget Sound Bull Trout

Bull Trout critical habitat was initially designated by USFWS in 2005. In January 2010, USFWS requested, and was granted, voluntary remand of the 2005 final rule and reconsidered critical habitat designations for Bull Trout. The revised final Bull Trout critical habitat rule was published on October 18, 2010. For the Skagit River basin upstream of the Sauk River confluence, the critical habitat designation includes most of the accessible stream habitat downstream of natural barriers and also includes the Project reservoirs to the U.S.-Canada border (Figures 4.5-21 and 4.5-22). USFWS defined Bull Trout critical habitat PBFs to include:

Bull Trout PBF 1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) that contribute to water quality and quantity and provide thermal refugia.

Bull Trout PBF 2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Bull Trout PBF 3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Bull Trout PBF 4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.

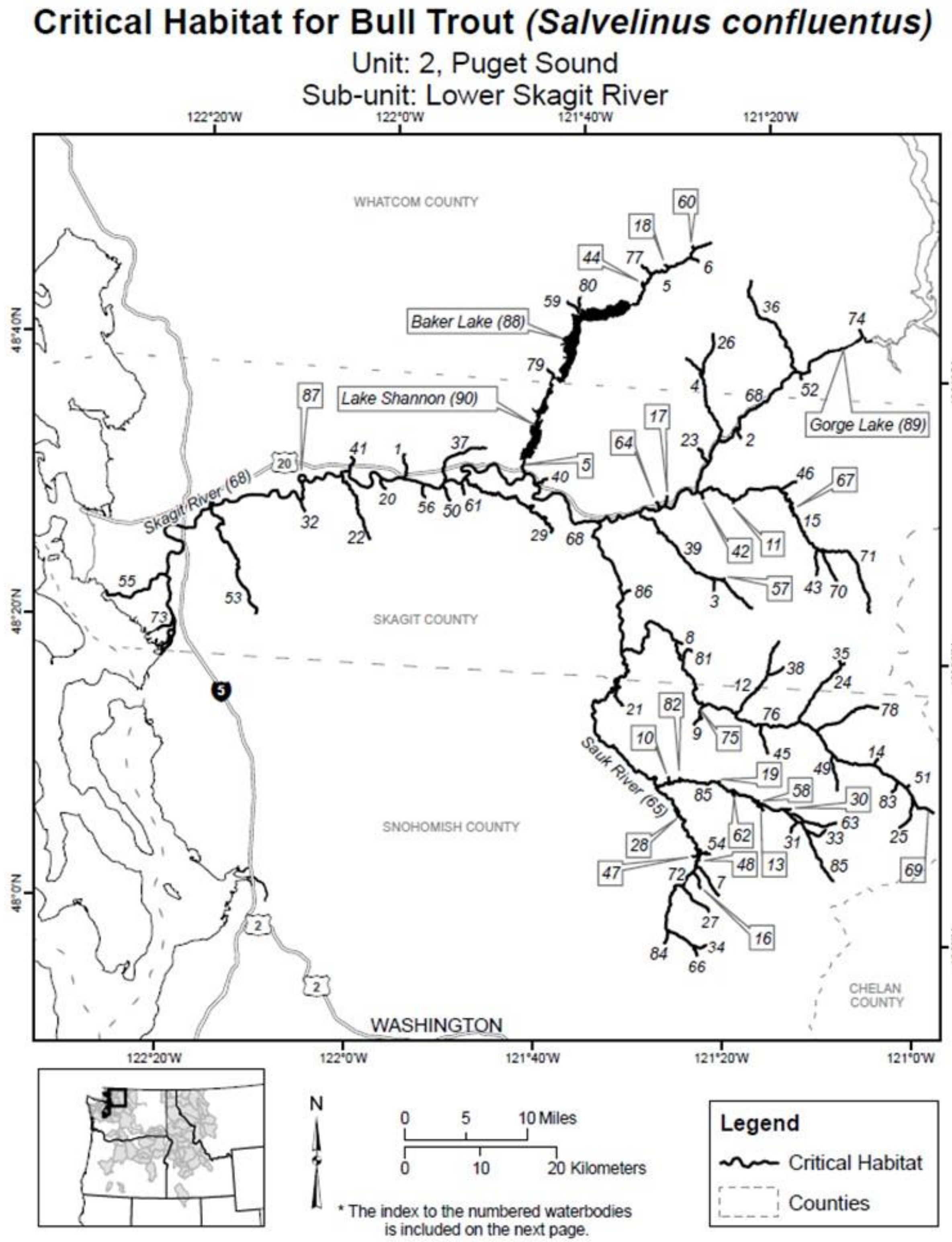
Bull Trout PBF 5. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on Bull Trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shading (e.g., provided by riparian habitat), streamflow, and local groundwater influence.

Bull Trout PBF 6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amount of fine sediment suitable to Bull Trout will likely vary from system to system.

Bull Trout PBF 7. A natural hydrograph, including peak, high, low, and base flows, within historical and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Bull Trout PBF 8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

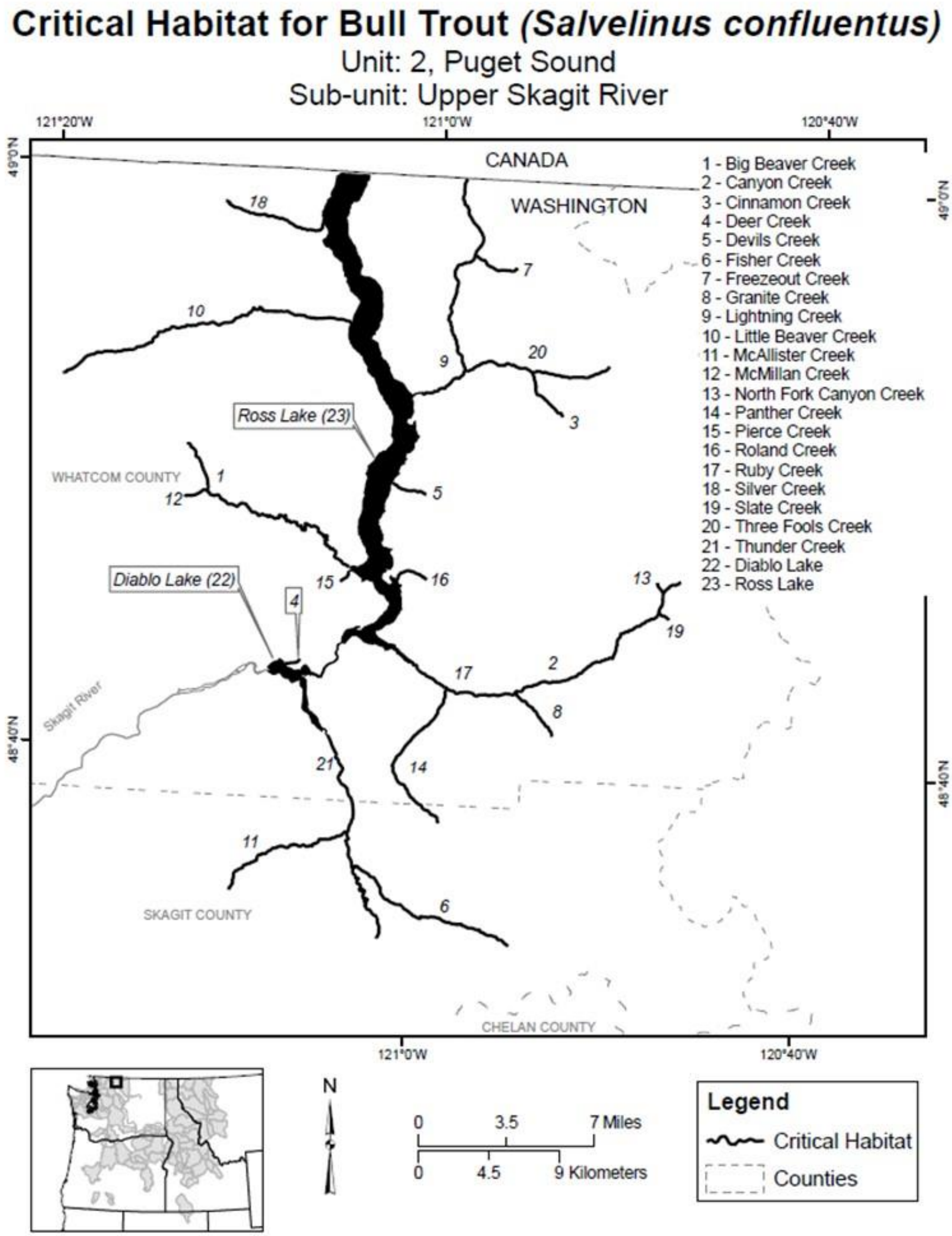
Bull Trout PBF 9. Sufficiently low levels of occurrence of non-native predatory (e.g., Lake Trout, Walleye, Northern Pike, Smallmouth Bass), interbreeding (e.g., Brook Trout), or competing (e.g., Brown Trout) species that, if present, are adequately temporally and spatially isolated from Bull Trout.



Source: USFWS 2010.

Note: Information related to numbered waterbodies can be found online at: https://www.fws.gov/pacific/bulltrout/crithab/washington/2%20Lower%20Skagit%20River2WaList.pdf/.

Figure 4.5-21. Bull Trout critical habitat designated in the Lower Skagit River Sub-Unit.



Source: USFWS 2010.

Figure 4.5-22. Bull Trout critical habitat designated in the Upper Skagit River Sub-Unit.

4.5.4.2 Magnuson-Stevens Fishery Conservation and Management Act – Essential Fish Habitat

The MSA established procedures 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 (Section 305(b)(2)). EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or to grow to maturity. The Pacific Fisheries Management Council has designated EFH and management objectives for three species of federally-managed Pacific salmon that occur in the Project vicinity: Chinook, Coho, and odd-numbered-year Pink Salmon (PFMC 2016); other salmonid species found within the Project Boundary or broader Project vicinity do not occur at federally-recognized commercial levels and therefore do not justify a FMP. Freshwater EFH for Pacific salmon includes all 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 (PFMC 1999).

4.5.5 Known or Potential Effects

4.5.5.1 Project-Related Effects

There were four major fisheries issues addressed during the previous relicensing process: (1) whether the Project influences the upstream migration of Pacific salmon; (2) the dewatering of the bypass reach; (3) increased potential for redd dewatering and fry stranding; and (4) the loss of off-channel habitat. The existing measures in the current Project license were designed to fully mitigate these issues; these measures have been effective for protecting and enhancing fish populations in and downstream of the Project. These include the instream flow plan (Flow Plan), which addresses spawning, incubation, rearing, and outmigration, and the non-flow measures (Non-Flow Plan), which include the construction of off-channel habitats, Rainbow Trout stocking in Gorge and Diablo reservoirs, and Chinook Salmon and steelhead research programs. City Light research programs have focused on addressing data gaps identified during recovery planning and limiting factors analyses, the efficacy of mitigation measures, and investigation of potential emerging Project effects on fisheries resources.

Unless otherwise cited, the majority of information in this section is summarized/adapted from City Light (2011), NMFS (2012), and USFWS (2013).

Connectivity and Habitat Access

Upstream Migration of Anadromous Fish

The Project has limited effect on the upstream passage of anadromous fish. As explained in sections 4.5.1.1 and 4.5.2.4, a steep and narrow boulder falls and cascade about 0.6 miles upstream of the Gorge Powerhouse constitutes a natural barrier to the upstream passage of salmon, and a similar feature is located farther upstream in the bypass reach, approximately 1.3 miles above the powerhouse (Envirosphere 1989). Although some steelhead appear to have negotiated these barriers at times, the number of upstream migrants appears to have been historically small.

Reservoir Tributary Access

Project operations have no net effect on fish access to Ross Lake's tributaries. Project operations inundate some tributary spawning areas when the reservoir begins to fill during spring and summer. These same areas are then exposed when the reservoir is drawn down during fall and winter (typically between elevation 1,535 and 1,602.5 feet[34]). However, City Light (1989a, b) concluded that the increase in spawning habitat gained from access to Big Beaver and Lightning creeks at normal maximum water surface elevation mitigates for the amount lost through inundation of alluvial fans. In its assessment of aquatic habitat in the tributaries to Ross Lake, City Light (1989a, b) assigned each tributary entering Ross Lake to one of three categories based on the effects of seasonal drawdown on the availability of Rainbow Trout spawning habitat. These categories and the tributaries included in each are presented in Table 4.5-15.

Table 4.5-15. The effects of the seasonal drawdown on the availability of Rainbow Trout spawning habitat in the tributaries to Ross Lake.

Category	Tributary to Ross Lake
Access to tributaries unaffected by the water surface elevation	Devils, Little Beaver, Roland, Ruby, and Silver creeks and the mainstem Skagit River
Tributaries with decreasing alluvial fan spawning habitat as the surface elevation increases	Arctic, Dry, Hozomeen, No Name, and Pierce creeks
Tributaries with increasing spawning habitat when historical barriers are submerged	Big Beaver (barrier submerged at elevation 1,597 feet) and Lightning (barrier submerged at elevation 1,596 feet) creeks

There is no net effect on tributary access resulting from accumulations of drift logs, drift boom logs, and sediment or debris within the drawdown zone of Ross and Diablo lakes and at the mouths of tributaries. As described in Section 4.5.6.1 of this PAD, City Light mitigates for this effect by annually conducting surveys for and removing these transitory barriers to spawning migration.

Downstream Gene Dispersal

It is unclear whether Project operations contribute to inbreeding depression of Bull Trout in Diablo Lake or Gorge Lake. Some Bull Trout entrained at Ross and Diablo dams survive downstream passage (see below), resulting in some downstream connectivity. However, lack of prolonged spill at Ross Dam (i.e., spill is infrequent at Ross Dam) may influence gene dispersal (City Light 2011) from Ross Lake populations to those in Diablo and Gorge lakes. Small Bull Trout populations may be able to persist without adverse genetic effects. Although genetic theory indicates that an effective population size of 50 or greater is necessary to prevent inbreeding depression, and 500 or greater is necessary to prevent genetic drift and allow for sustainability over ecological time, Hudson et al. (2017) suggest that relatively small Bull Trout populations can persist with no significant evidence of genetic drift, even when potentially isolated, raising questions about the interpretation of the "50/500 rule" relative to recovery of Bull Trout.

[34] The lowest licensed water surface elevation for Ross Lake is 1,474.5 feet, 127 feet below normal maximum water surface elevation (Figure 3.5-1), which has occurred only once in the current license period (in April 1999). Between 2009 and 2018, the average low water surface elevation was 1,535 feet.

Origin and Connectivity of Ross Lake Fish Populations

There is no evidence that the Project has contributed to the isolation of salmonids in Ross Lake and its tributaries (see Section 4.5.1.1 of this PAD). In contrast, intermixing of previously isolated populations may have been facilitated by inundation of previously impassable barriers (e.g., Big Beaver Creek). As noted above, evidence indicates that the upper Skagit River once flowed into the Fraser River (Riedel 2007). Smith (2019) indicated that Bull Trout populations in the Upper Skagit Core area are the result of a founding population from the Fraser River. Smith (2019) based this conclusion on an analysis of mitochondrial haplotypes of Bull Trout from the Fraser and Skagit rivers. Smith (2019) suggests that the most likely mechanism for dispersal into the Skagit River above the current location of Gorge Dam is through the upper Skagit River from the Fraser River. This pathway is corroborated by Riedel (2007). This is consistent with the fact that Bull Trout and Rainbow Trout below Gorge Dam are significantly genetically different from those in the upstream reservoirs (Smith 2010; Small et al. 2016), and Dolly Varden only occur upstream of the gorge. Rainbow Trout in Stetattle Creek are also genetically distinct from steelhead in the Skagit River (Kassler and Warheit 2012, as cited in Pflug 2013). These genetic differences coupled with the geologic history of the basin strongly suggest that salmonids in the upper Skagit River basin originated in the Fraser River. The salmonid populations in Ross Lake and its tributaries are robust and self-sustaining, and there is no indication that they are being adversely affected by the presence of the Project's dams.

Instream Flows

Flow Fluctuations

City Light's three developments on the Skagit River are operated as a single project to store water on a seasonal or daily basis and then release it later for a variety of beneficial uses, such as flood control and downstream salmonid protection. As explained in greater detail in sections 3.5.1 and 4.5.6.1, flows in the Skagit River downstream of Gorge Powerhouse are stipulated by the current Project license (FERC 1995), which fully incorporates the measures included in the FSA Flow Plan, as amended in 2011. The flows and ramping rate restrictions currently in place provide the following benefits: (1) salmon spawning and redd protection; (2) salmon fry protection; (3) steelhead spawning and redd protection; (4) steelhead fry protection; (5) fry outmigration; and (6) steelhead and Chinook Salmon yearling protection.

Analyses of the abundance and distribution of Chinook Salmon, Pink Salmon, and Chum Salmon in the mainstem Skagit River between the Sauk River confluence and Gorge Powerhouse demonstrates that the flow management measures have had a beneficial effect on the salmon populations spawning in the reach (Connor and Pflug 2004). Spawner abundance of all three species progressively increased in an upstream direction following implementation of flow measures, and increases were greatest in the reach immediately downstream of the Gorge Powerhouse, suggesting that the effects of flow manipulation diminished with increasing distance downstream of the Project. Pink and Chum species commonly spawn along the shallow channel margins of the Skagit River (Stober et al. 1982). Increases in Pink and Chum salmon spawner abundance were linked to the reduced risk of redd dewatering and protection of these shallow margin areas (Connor and Pflug 2004). Reduction in stranding rates also appeared to increase the abundance of Pink and Chum salmon.

In contrast to Pink and Chum salmon, Chinook Salmon spawner abundance was only observed to increase within the upstream-most of the three reaches[35] examined. Because Chinook Salmon generally spawn in relatively fast and deep water (Stober et al. 1982), it was concluded that they have a substantially lower risk of redd dewatering compared to Pink and Chum salmon. It is believed that flood protection measures, which reduce the risk of scour, also protect incubating Chinook eggs. In addition, reductions in the magnitude and rate of downramping reduced the risk of Chinook Salmon fry stranding. Together these factors contributed to the observed increase in Chinook Salmon spawner abundance in the upper reach (Connor and Pflug 2004).

In contrast, steelhead spawner abundance between the Gorge Powerhouse and Sauk River has not increased in response to the implementation of City Light's flow measures. In part, this may be the result of Bull Trout predation on steelhead. Lowery and Beauchamp (2015) identified fry and parr as key components of the fluvial Bull Trout diet. Model simulations run by Lowery and Beauchamp predicted Bull Trout predation to have a potentially negative effect on juvenile steelhead abundance, depending on the abundance of piscivorous Bull Trout. The short-term population-level effects of predation on steelhead could be manifested in a low rate of steelhead adult returns to the reach between the Gorge Powerhouse and Sauk River. Juvenile Chinook Salmon were found to be a relatively low contribution to the diet of fluvial Bull Trout, despite the year-round spatial and temporal overlap between Bull Trout and Chinook Salmon. Lowery and Beauchamp (2015) concluded that escapement to the Skagit River upstream of the Sauk River suggests that steelhead are more vulnerable to Bull Trout predation than Chinook Salmon.

Entrainment

The Skagit River Project's intake structures and spillways are unscreened and, as a result, fish rearing in or migrating through the Project reservoirs could be entrained into the Project's intakes and turbines or pass through the Project's spillways during spill events. If fish become entrained into these facilities, they may survive and add to the fish populations located downstream of the powerhouse, or be killed, injured, or preyed upon.

Entrainment was not studied as part of the previous Project relicensing. However, when City Light submitted its 2011 application for a non-capacity amendment of the license (for the construction of a second power tunnel between Gorge Dam and Powerhouse), the USFWS requested additional information to address potential impacts of entrainment on Bull Trout at Skagit River Project facilities. Bull Trout was not an ESA-listed species at the time of the previous relicensing but was listed by the time of the amendment application.

As a component of its Biological Opinion associated with the addition of the second power tunnel at the Gorge Development, USFWS (2012) analyzed the potential effects of entrainment on the Bull Trout population in Gorge, Diablo and Ross lakes. Unless otherwise cited, the following section is summarized from this Biological Opinion. Yearly entrainment is summarized from City Light's annual incidental take reports prepared for the 2013 through 2018 monitoring years (City

[35] The study area was segregated into three reaches for the spawner and redd surveys: (1) Newhalem to the confluence of the Cascade River (reach 1; 16 miles); (2) the Cascade River to the confluence of the Sauk River (reach 2; 11 miles); and (3) the Sauk River to the confluence of the Baker River (reach 3; 10 miles).

Light 2014, 2015, 2016, 2017, 2018, 2019), as required by USFWS's Biological Opinion (USFWS 2013).

The potential for turbine entrainment at Gorge, Diablo, and Ross powerhouses occurs whenever the Project is generating, which is nearly continuous year-round. During short periods of planned and un-planned plant outages, water does not typically flow through the intake structures and may instead pass over the Project's spillways. Water is also passed over the spillways during flood events. Spill frequency varies between the three developments (see Section 3.5.1 of this PAD for a description of spill frequency at each development). Spill volume and duration vary greatly, ranging from a few hundred to a few thousand cfs and for as short as an hour to several days or weeks depending on the circumstances. The likelihood that Bull Trout would pass through one of the spill pathways is a function of which spillway is open and passing flow, combined with the time of year relative to Bull Trout life history and movement patterns both laterally and vertically in the water column. The risk of injury or mortality associated with passage through these spillways is a function of the conditions that would be experienced by the fish during the passage and upon reintroduction to the river in the tailrace below each dam. It is expected that the greatest impact on fish passing through spill would occur upon entrance of the plunging flow into the tailrace.

In its annual entrainment reports, City Light describes its observations of acoustically tagged Bull Trout that were either entrained into the Project intakes or passed the dams via spill (City Light 2014, 2015, 2016, 2017, 2018, 2019). City Light also estimates Bull Trout spillway mortality through a calculation based on:

- Annual spill duration at each dam;
- The amount of time acoustically tagged Bull Trout spend in the vicinity of the spillway at each dam;
- An assumed total adult Bull Trout population abundance in each reservoir; and
- An assumed spillway mortality of 100 percent at Ross Dam, 55 percent at Diablo Dam, and 10 percent at Gorge Dam, as stipulated in USFWS (2012).

Annual estimates of turbine and spillway entrainment at each Project development from 2013 through 2018 are presented in Table 4.5-16.

Table 4.5-16. Annually reported adult Bull Trout entrainment and estimated passage metrics at Project dams (2013-2018).

Year	Intake Entrainment (observed via acoustic telemetry)	Spillway Mortality (calculated with spill duration estimation method)
Ross Dam		
2013	0	0
2014	0	0
2015	0	5
2016	0	0
2017	0	0
2018	0	0
Diablo Dam		
2013	0	8
2014	0	21
2015	0	4
2016	1[1]	6
2017	0	52
2018	1[1]	54
Gorge Dam		
2013	0	1
2014	0	8
2015	0	2
2016	0	6[2]
2017	0	4
2018	0	5

1 Bull Trout entrained into the Diablo intake survived downstream passage.
2 Includes one Bull Trout spill-related entrainment mortality observed via acoustic telemetry.

Between 2013 and 2018, City Light documented two tagged Bull Trout being entrained at the Diablo Dam intakes (Table 4.5-16); however, both fish survived passage through the turbines as evidenced by their continued movements (via the acoustic tags) following each event. Both of these fish were relatively large, measuring over 500 mm in length. In 2016, the overall acoustic-tagged Bull Trout passage rate at Diablo Dam was 25 percent (1 of 4 active tags present in Diablo Lake), and in 2018 it was 9 percent (1 of 11 active tags present in Diablo Lake). These findings demonstrate that Bull Trout can survive passage through the Diablo Powerhouse.

In 2016, 1 of the 11 fish with active acoustic tags in Gorge Lake was last documented in the forebay during a 26-day spill event. This fish most likely passed downstream over the spillway and was killed in the process, as it was never detected again (Table 4.5-16).

Based on the results of these studies, it is apparent that Bull Trout entrainment is relatively uncommon at Ross and Gorge dams (via the intake routes); however, it may be more common at Diablo Dam as evidenced by the successful passage of Bull Trout (via a turbine intake route) in two of six years. Passage over the spillways at Ross Dam appears to be relatively rare given the limited number of spill events that occur at this facility (see Section 3.5.2.1). Spillway passage is assumed to be more common at Diablo and Gorge dams, although only one Bull Trout was documented (via acoustic telemetry) to pass over the Gorge Dam spillway during the six-year study (Table 4.5-16). No tagged Bull Trout were documented passing over Diablo Dam spillway, although Bull Trout entrainment was estimated via the spill duration method for the purposes of annual entrainment estimation as required by USFWS's Biological Opinion (USFWS 2013).

Entrainment rates for other species are unknown, though successful Rainbow Trout entrainment/downstream passage has been documented at the Project in the past (City Light 2011).

Channel Conditions

Sediment

Under existing conditions, Ross, Diablo, and Gorge dams intercept all coarse sediment (sand gravel, cobble, and small boulders) entering the Skagit River upstream of Gorge Dam (NMFS 2012).[36] While these sediments likely provide productive habitats for fish, BMIs, and native aquatic macrophytes at the tributary deltas in the reservoirs, the Project also reduces the amount of coarse sediment entering the river downstream of Gorge Dam. Nevertheless, adverse effects on salmonid spawning habitat appear to be minimal in the reach of the Skagit River mainstem between Gorge Powerhouse and the Sauk River confluence, as high-quality spawning gravel is abundant in the river below the Project, and large amounts of gravel move into the river each year from tributaries (NMFS 2012). For example, sufficient bedload sediment is recruited from Ladder Creek and other tributaries in the Gorge bypass to provide spawning habitat immediately downstream of the Gorge Powerhouse. Flow management may partially offset some of these gravel losses by decreasing the frequency and magnitude of peak flows that move gravels through the system (Conner and Pflug 2004; NMFS 2012). As noted in Section 4.3 of this PAD, landslides, and past and current timber harvest in sub-watersheds downstream from Gorge Powerhouse, have been documented to increase coarse sediment loads to streams entering the Skagit River (Paulson 1997). The combined effect of reduced peak flows and increased coarse sediment loads may result in increased spawning gravel availability in this section of the Skagit River.

Annual spawner and redd surveys suggest appropriate-sized substrate is widely distributed in the mainstem Skagit River between Gorge Powerhouse and the Sauk River confluence and is dominated by small- and large-sized gravel and cobble located on extensive gravel bars (Conner and Pflug 2004). The Skagit Chinook Recovery Plan (SRSC and WDFW 2005) does not consider the Upper Skagit Summer Chinook Salmon population to be limited by spawning gravel availability, but expresses a concern about relatively high sediment loads from some tributary streams and the potential effects of fine materials that could reduce the quality of spawning habitat, and the potential effects of scour in places where bedload aggradation occurs.

Woody Debris

LWD is an important component of aquatic ecosystems in both riverine and reservoir habitats because it influences fluvial hydraulics, thereby enhancing aquatic habitat complexity; provides

[36]The majority of the suspended (fine) sediment entering these waterbodies is transported to the river reaches below Ross Dam.

instream cover for fish and a substrate for aquatic invertebrates; contributes allocthonous nutrients as it decomposes, and can trap sediments that aid in the establishment of riparian vegetation (Bjornn and Reiser 1991; Northcote and Atagi 1997). According to Collins (1998), LWD resources have been significantly depleted in the Skagit River basin and across the Pacific Northwest since European colonization, and this loss is directly connected to extensive salmonid habitat degradation throughout the basin and the region.

Operation of the Project also reduces the frequency and magnitude of high flow events in the Skagit River, which limits LWD recruitment downstream of the dams. Before the dams were constructed, major flood events were unregulated and had more potential to move wood downstream, inundate the floodplain, create new off-channel features, and recruit large wood from riparian areas and floodplain forests (Beamer et al. 2005). The Skagit River still receives LWD inputs from the mainstem downstream of Newhalem, the entire Sauk-Suiattle tributary watershed, the Cascade River, and numerous smaller tributaries. Nonetheless, LWD supply is likely highly limited compared to historical levels due to the multiple impacts of hydroelectric infrastructure, timber harvest, agriculture, flood control, log jam removal, and rural and urban development which limit LWD input and available size (NSD 2017; Beamer et al. 2005; Collins 1998). However, as noted in Section 4.5.2.1 of this PAD, of the wood entering Ross Lake, approximately 0.5 percent consists of large trees and 2.5 percent includes rootwads. The remainder (97 percent) consists of smaller logs and limbs. Some of the LWD which enters Ross, Diablo, and Gorge lakes is moved into the Skagit River downstream from the Project (see Section 3.5.1 of this PAD).

Riverine Shorelines Downstream of Gorge Powerhouse

The creation, maintenance, and continued availability of off-channel habitat is a dynamic process that changes over time. It is largely controlled by episodic events, primarily major floods. In the mainstem Skagit River, the formation, availability, and quality of off-channel habitat is currently limited due to flood control operations at the Project and land use changes.

Flows in the Skagit River downstream of Gorge Powerhouse are managed to support a variety of Project purposes, including the protection of anadromous fish and flood control. These operations have influenced channel-forming processes by reducing the frequency and magnitude of downstream floods. These effects are attenuated with increasing distance downstream of the Project as tributary inflows enter the Skagit River. Major tributary inputs derive from the Cascade River, the Sauk River, and the Baker River, which are located 16, 27, and 38 miles downstream of Gorge Powerhouse, respectively. No recent comprehensive inventory of channel migration has been conducted in the Skagit River upstream of the Sauk River confluence, but analysis completed for the previous relicensing process (Riedel 1990) found only minor amounts of channel migration in the Skagit River upstream of the Sauk River confluence. The analysis suggested that the reduced peak flows and vegetated riverbanks limited channel migration as well as cumulative effects from hydro-modified banks and changes to LWD and sediment loading. A recent inventory of hydro-modified banks (riverbanks stabilized by rip rap) found that approximately 14.5 percent of the right bank of the Skagit River between Gorge Powerhouse and the Sauk River was hydro-modified, with 1.5 percent of the left bank protected by rip rap (Hartson and Shannahan 2015). In the Middle Sauk River, between the Sauk confluence and the Highway 9 Bridge, approximately 17 percent of the right bank and 10 percent of the left bank was hydro-modified.

Reservoir Operations

Trapping and Stranding

Under the current Project license, Ross Lake water surface elevations are typically maintained between a normal maximum of 1,602.5 feet during summer and 1,535.0 feet during fall and winter (a difference of 67 feet).[37] Diablo Lake typically fluctuates 4 to 5 feet on a daily basis, although it can be drawn down as much as 12 feet for maintenance. Gorge Lake typically fluctuates 3 to 5 feet on a daily basis but it can be drawn down as much as 50 feet during maintenance. City Light's monthly operations plan states that if the water surface elevation of Gorge Lake is drawn down below 867 feet, City Light's Project Fish Biologists will be contacted within 48 hours to conduct a stranding/entrapment assessment at known locations where stranding may occur. Water surface elevations below 86 feet generally occur every few years and are related to Project maintenance.

In April 2019, drawdown of Gorge Lake resulted in the stranding of fishes as observed by City Light, NPS, and Upper Skagit Indian Tribe biologists. These observations were reported to the FCC/NCC at an April 23 meeting. At that meeting it was agreed that City Light would analyze a subsample of stranded fishes and report back the FCC/NCC when results become available from a third party laboratory. The substance of the report will include a description of operations during the drawdown, a genetic analysis of the fishes collected, stocking records of Gorge Lake (if applicable), the results of a hydraulic model used to describe the event and possible operational measures that can minimize or eliminate stranding risk, and recommendations to minimize or eliminate stranding risk. The NPS also authored a report of its observations during the same event. In addition, City Light will conduct an inventory of trapping/stranding risk as part of relicensing, which is described in Section 5 of this PAD.

Aquatic Habitat Productivity

The effects of reservoir operations on the passage of native resident fish to spawning tributaries is discussed above in Connectivity/Habitat Access. The only lake-spawning fish species in the Project reservoirs is the non-native Redside Shiner. Since the species' introduction to Ross Lake in the 2000s, Redside Shiner populations have grown to be extremely large. Reservoir operations do not appear to limit the productivity of this introduced fish species in Project reservoirs.

The effects of the seasonal drawdown on the amount of available lacustrine habitat for trout and char have not been examined for Ross Lake; however, Ross Lake is deep with steep shorelines for most of its length, and the only relatively shallow portion is the northern area near the Skagit River delta. On average, approximately 7,886 acres of lacustrine habitat is transformed into about 5.3 miles of riverine habitat during seasonal drawdowns. Despite the oligotrophic status (see Section 4.4.5.2 of this PAD) and current operating regime in Ross Lake, native fish populations in Ross Lake appear to be relatively abundant and self-sustaining (see Section 4.5.1.3 of this PAD).

[37] The lowest licensed water surface elevation for Ross Lake is 1,474.5 feet, 127 feet below normal maximum water surface elevation (Figure 3.5-1), which has occurred only once in the current license period (in April 1999). Between 2009 and 2018, the average low water surface elevation was 1,535 feet, a difference of 67 feet.

Water Quality

Upstream of Gorge Dam

As described in Section 4.4 of this PAD, the Project has minimal impact on water quality in the upper Skagit River. There is a large volume of cold water in Ross Lake throughout summer and fall, when fish in the lake could be subject to thermal stress due to elevated air temperatures. As shown in Figure 4.4-10a, mean daily water temperatures in Ross Lake during summer can be as high as approximately 21°C in shallow depths (to 25 feet), but cooler water (less than 14°C) persists throughout the year below a depth of approximately 100 feet (Figure 4.4-10a). These warmer water temperatures in the surface water may approach the thermal maximum of some species in the reservoir, but the large volume of cooler water found at depth remains within the optimal temperature range for rearing (Table 4.5-2).

Water temperature monitoring in both Diablo and Gorge Lake has shown mean daily water temperatures very rarely exceed 16°C in Diablo Lake and 13°C in Gorge Lake (Figure 4.4-10b-c). These summer water temperatures are well within the thermal optimum for fish rearing in the lakes (Table 4.5-2). All other water quality parameters appear to be within suitable ranges for aquatic biota.

Downstream of Gorge Dam

There are no minimum flow requirements for the bypass reach, and it has special condition status under State standards requiring that water temperatures do not exceed 21ºC as a result of anthropogenic activities. Except during spill events at Gorge Dam, the only instream flow in the 2.5-mile reach upstream of Gorge Powerhouse is from accretion, spill-gate seepage, tributary input, and precipitation runoff. Limited historical monitoring found that water temperatures in the bypass reach did not exceed 21ºC (Envirosphere 1988). Given that there is limited habitat available for aquatic biota in the bypass reach, water quality is not expected to have a negative effect on fish and aquatic resources in the bypass reach.

Because the Project is within a largely undeveloped watershed in the North Cascade Mountains, water quality meets exceptional narrative water quality criteria throughout the year in the reach of the Skagit River between the Gorge Powerhouse and the Sauk River confluence (Table 4.4-14). Monitoring of water temperature in the Skagit River at Marblemount shows that summer temperatures are typically below 15ºC, and did not exceed Ecology's 7-DADMax criterion for Core Summer Salmonid Habitat (16ºC), and rarely and only slightly exceeded the 7-DADMax criterion for Spawning and Incubation Protection Temperature criterion for September (13º C) (Figure 4.4-12, Table 4.4-11). These temperatures are within the optimal rearing range for anadromous fish in the Skagit River (Table 4.5-2).

No other water quality parameters are known to exceed Ecology's standards downstream of Gorge Powerhouse and are expected to be within suitable ranges for aquatic biota. As described in Section 4.4 of this PAD, the Skagit River is not Clean Water Act Section 303d designated for any parameter between the Gorge Powerhouse and the Sauk River confluence. Therefore, the Project is not having a negative effect on water quality downstream of the Gorge Powerhouse.

Transmission Line Stream Crossings

The Project's transmission lines parallel the Skagit River to about RM 75 and also cross the Sauk, Stillaguamish, Snohomish, and Cedar-Sammamish watersheds. City Light performs maintenance to clear vegetation within and near these corridors, potentially affecting riparian vegetation, channel migration, and instream conditions at and downstream of the corridors. Potential impacts include loss of native vegetation, lost recruitment of LWD, bank destabilization, or bank armoring. City Light protects infrastructure (i.e., armored/fortified towers), which could impact instream and floodplain processes. Potential impacts include reduction of channel migration, loss or minimization of alluvial fan function, effects on floodplain inundation, and reductions in instream habitat complexity. Service roads used to maintain the transmission line corridors could also have impacts if they have undersized or blocked culverts, isolate wetlands, or alter instream habitat. Such impacts were not addressed during the last relicensing process and have not been subsequently studied or documented. To better understand possible impacts, City Light is proposing to conduct an inventory of transmission line stream crossings, as described in Section 5 of this PAD.

4.5.5.2 Cumulative Effects

A variety of activities in the Skagit River watershed, Puget Sound, and the Strait of Juan de Fuca have resulted in cumulative impacts to fish and aquatic resources that may also be affected by the continued operation of the Skagit River Project. These activities include the construction and continued operation of the Baker River Hydroelectric Project; the construction and maintenance of roads, railroads, and levees; timber harvest; agriculture; dredging; hatchery production; commercial and recreational fisheries; the introduction of non-native fish species, continued development in the floodplain; and historical and proposed mining in the upper Skagit River basin.

Operation of both the Skagit and Baker river projects alters the natural hydrology and geomorphology in the Skagit and Baker rivers, which in turn affects the quality and quantity of aquatic habitat for resident and anadromous fish. Road building, timber harvest, and farming and grazing are also pervasive in the Skagit River watershed outside of the North Cascades National Park. These land management activities are known to increase the sediment supply to streams through associated mass wasting, surface erosion, or bank erosion, and can adversely affect water quality and water temperatures. Early hatchery practices in the Pacific Northwest were also initially responsible for loss of natural-origin salmon and steelhead stocks through genetic introgression, competition, and predation, and impacts from construction and operation of hatchery facilities (HSRG 2003). These practices, in combination with overharvest (both recreational and commercial), have led to dramatic declines in the abundance of Chinook Salmon, steelhead, and Bull Trout in the region and their eventual listing under the ESA.

In addition to these past and present impacts, continued climate change may cause alterations to hydrology and hydraulics in the Skagit River basin. For example, the Skagit River Basin Climate Science Report (Lee and Hamlet 2011) forecasts that increases in peak floods could increase on average by about 40 percent. Higher winter flows, especially flood discharges, could increase redd scour risk for mainstem spawning fishes and increase sediment transport which would likely cause increased deposition in the lower Skagit River. Reductions in snowpack and continued glacial recession may also result in less water for power generation, fishery resources, domestic water supply, and irrigation.

Future mining activities also have the potential to cumulatively affect aquatic resources in the Skagit River basin. Imperial Metals Corporation recently applied for permits to search for gold and copper in the Skagit River headwaters in British Columbia, which, according to Imperial Metals' permit application, would entail exploratory mining and involve building roads, helicopter landing sites, air strips, boat ramps, and settling ponds as well as surface drilling.

In recent years, resource managers have developed a suite of recovery and management plans that are designed to address many of impacts on and facilitate the recovery of ESA-listed salmonid stocks. These actions are identified in the WDFW/SRSC Skagit Chinook Recovery Plan (SRSC and WDFW 2005), Puget Sound Partnership Salmon Recovery Plan (Shared Strategy for Puget Sound 2007), Proposed Recovery Plan for the Puget Sound DPS (NMFS 2018), Skagit County Habitat Improvement Plan (Skagit County 2012), Skagit Watershed Council Strategic Plan for Salmon Habitat Restoration (Skagit Watershed Council 2000), and the WDFW/Tribal Hatchery and Harvest Programs. PSE's Baker River Project Settlement Agreement also includes numerous PME measures designed to mitigate the effects of that project on aquatic resources (PSE 2004).

Any new actions developed by City Light during the Skagit River Project relicensing, combined with the recent recovery efforts being implemented in the region, are expected to have an incremental, beneficial cumulative effect on Chinook Salmon, steelhead, and Bull Trout populations, and other aquatic biota in the Skagit River basin.

4.5.6 Existing or Proposed Protection, Mitigation, and Enhancement Measures

4.5.6.1 Existing Measures

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources in cooperation with LPs, including federal and state agencies, tribes, and NGOs. These efforts include both flow-related and non-flow related measures, which are briefly described below.

Rainbow Trout Broodstock Program (Diablo Lake and Gorge Lake Stocking)

The 1991 Settlement Agreement for relicensing the Skagit River Project provided for the creation of a native Rainbow Trout broodstock program, which involved collection of fish from Ross Lake to produce hatchery fish to supplement the Gorge Lake and Diablo Lake Rainbow Trout fisheries. The rationale for this program was to compensate for lost habitat in the bypass reach downstream of Diablo Dam as stated in the current Project license order. WDFW began collecting broodstock annually from Roland and Dry creeks for the stocking program in 2002 as a component of City Light's resident fish mitigation program. The 1991 Settlement Agreement stated the goal would be to produce 400,000 fingerling Rainbow Trout each year. Actual annual releases of upper Skagit hatchery Rainbow Trout have ranged from 1,000 to 286,000 fish into Diablo Lake, and 2,040 to 4,000 fish into Gorge Lake to enhance the popular recreational fishery (Downen 2014). Starting in 2010, an updated production target was agreed upon by City Light, NPS, and WDFW. These goals were to (1) annually produce 265,000 Rainbow Trout fry (1,200/lb) to be stocked in September of each year in Gorge (95,000) and Diablo (170,000) lakes and (2) annually produce 95,000 Rainbow Trout fingerlings (200/lb) to be stocked in May of each year into Gorge (20,000) and Diablo (75,000) lakes, and to maintain the broodstock to support the program.

Reservoir Tributary Barrier Removal

To facilitate spawning of resident Rainbow Trout in tributary drawdown zones of Project reservoirs, the 1991 Settlement Agreement stipulates that City Light is to survey for and remove transitory barriers to spawning migration; such barriers include drift logs, drift boom logs, and accumulations of sediment or debris caused by Project operations between the minimum and maximum reservoir elevations. Specifically, the 1991 Settlement Agreement requires the following:

> *Before April 1 of each year, City Light shall conduct inspections within the United States portion of the Ross Lake tributary drawdown zones and at the mouths of Diablo and Gorge tributaries. The following Ross Lake tributaries shall be surveyed annually: Lightning, Roland, Little Beaver, Big Beaver, Devils, Silver, Ruby, Arctic, Dry, Hozomeen, and Pierce creeks (this list may be modified at the discretion of the NCC). Any transitory barriers identified and determined by WDW and NPS to be detrimental to trout migration shall be removed by City Light crews. City Light shall remove the detrimental barriers as soon as possible after identification and confirmation. Surveys shall be conducted by City Light to monitor the effectiveness of barrier removal. These surveys will be made when Rainbow Trout spawners are expected to be present in the tributaries.*

This action was deemed necessary to improve access to the existing spawning habitat in support of Rainbow Trout reproduction. The results of these barrier surveys and barrier removal efforts over the last 10 year period are summarized in Table 4.5-17. Barrier identification is coordinated with NPS and WDFW annually. Once a barrier is identified, City Light takes before-and-after photos of the removal and reports this information to the FCC/NCC.

In a voluntary agreement with LPs, City Light has agreed to expand annual barrier surveys and removal efforts to include the fall to facilitate native char migration. These fall surveys will begin in 2020 following NCC approval.

Table 4.5-17. Results of City Light's tributary barrier survey and removal (1999-2019).[1]

Year	Arctic	Big Beaver	Devils	Dry	Lightning	Light Beaver	No-Name	Pierce	Roland	Ruby	Silver	Skymo	Thursday
1997	0	0	0	1	0	0	0	0	N/A	N/A	N/A	N/A	0
1998	0	0	N/A	0	0	N/A	0	1	1	N/A	N/A	N/A	1
1999	N/A	N/A	0	2	N/A	N/A	N/A	0	1	N/A	N/A	N/A	1
2000	0	0	0	1	0	0	0	0	0	N/A	N/A	N/A	0
2001	0	N/A	0	0	0	0	0	2	0	N/A	0	N/A	0
2002	0	0	0	0	0	0	0	1	0	N/A	N/A	N/A	0
2003	0	0	N/A	1	0	N/A	N/A	0	0	N/A	0	N/A	0
2004	N/A	0	N/A	0	0	0	N/A	0	0	N/A	N/A	N/A	0
2005	N/A	N/A	N/A	0	0	N/A	N/A	0	0	0	0	N/A	0
2006	N/A	N/A	N/A	0	N/A	N/A	N/A	0	0	N/A	N/A	N/A	0
2007	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2008	N/A	0	N/A	1	0	N/A	N/A	0	0	0	N/A	N/A	0
2009	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2010	N/A	0	0	1	0	0	N/A	0	0	0	0	N/A	N/A
2011	N/A	0	N/A	1	0	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A
2012	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2013	0	0	N/A	1	0	0	N/A	0	0	N/A	N/A	N/A	N/A
2014	0	N/A	N/A	0	0	N/A	N/A	0	0	N/A	0	N/A	N/A
2015	0	0	0	0	0	0	N/A	0	0	0	0	N/A	N/A
2016	0	0	0	1	0	0	0	0	0	N/A	0	0	N/A
2017	0	N/A	N/A	1	0	0	0	N/A	0	N/A	0	0	N/A
2018	0	0	0	0	0	N/A	0	0	0	N/A	N/A	0	N/A
2019	N/A	N/A	N/A	2	0	N/A	N/A	0	0	N/A	N/A	N/A	N/A
Total Barriers	0	0	0	13	0	0	0	4	2	0	0	0	2

Source: City Light unpublished data reported to the FCC and NCC.

1 N/A means the stream was not surveyed in that year; 0 means the stream was surveyed, but no barriers were identified.

Fry Stranding Surveys

City Light's 1991 Settlement Agreement specifies that one of the functions of the FCC is to develop and supervise annual salmon and steelhead fry stranding surveys. The 1991 Settlement Agreement states that fry stranding surveys will be conducted annually for a period of no less than three years to monitor the effectiveness of the fry protection measures and that surveys will be conducted during the peak vulnerability periods of both the salmon and steelhead fry. After three years, annual fry stranding surveys were not mandated by the FCC, although periodic stranding studies have been conducted since the initial three-year period.

The 2013 FERC Amended License states that the Skagit River Project is subject to the reasonable and prudent measures and terms and conditions of NMFS's Biological Opinion (NMFS 2012), which requires City Light to report annual incidental take of Puget Sound Chinook Salmon and Puget Sound Steelhead to NMFS by March 31 of each year. To ensure that incidental take levels are not exceeded, FERC also directed City Light to prepare a Chinook Salmon and steelhead Monitoring Plan in conjunction with NMFS and subject to FERC approval. This plan, as approved by NMFS, was submitted to FERC in March 2014. The Monitoring Plan includes six elements to determine take from each of the six Project actions identified in NMFS's Biological Opinion for the Project; one of the six elements was to measure current fry stranding potential by conducting fry stranding surveys.

The Monitoring Plan called for at least one Chinook Salmon and one steelhead fry stranding survey. The protocol for these surveys is to sample 300 feet of bar at two locations during both the salmon and steelhead fry periods, with survey results reported as fry stranded per 100 feet of bar per R.W. Beck and Associates (1989). Stranding risk is greatest when the slope of the bar is less than 5 degrees. Surveys were attempted in 2015, but flows were too low for the surveys to occur. The FCC then determined that at least two complete surveys, two salmon periods and two steelhead periods, should be conducted over three years. In 2016, surveys were conducted during both periods resulting in a stranding rate of 0.00/100 feet for salmon fry and 0.05/100 feet for steelhead fry. Due to low natural flows in August and September, only salmon fry stranding surveys were conducted in 2017. Two salmon fry were found (one Chum Salmon and one unidentified salmon), which represents a stranding rate of 0.067/100 feet. In 2018, surveys were conducted during both the salmon and steelhead fry periods. Two stranded fry were observed during the surveys (one Chum and one Chinook); the resulting salmon stranding rate was 0.067/100 feet and the steelhead rate was 0.00/100 feet. The results of the 2016, 2017, and 2018 surveys indicate a stranding rate for salmon and steelhead fry that is substantially lower than the 0.78/100 feet recorded by R.W. Beck and Associates (1989) during the previous relicensing surveys.

Although not a current Project license measure, City Light also conducts stranding/entrapment surveys if the water surface elevation of Gorge Lake is drawn down below 865 feet as per its monthly operations plan.

FSA Flow Plan

From 1991–2012, flows in the Skagit River downstream of Gorge Powerhouse were stipulated by the current Project license (FERC 1995), which fully incorporates the measures included in the FSA Flow Plan (City Light 1991). The Project license was amended in 2013 to incorporate a Revised FSA Flow Plan (City Light 2011) that included four measures that City Light had been implementing voluntarily since 1995 to further reduce Project effects on steelhead and salmon. The specific flow measures, as well as ramping rate restrictions, for each species and life stage, that are included in the Project license, as amended (FERC 2013), and the Revised FSA Flow Plan (City Light 2011) are briefly described below and discussed in detail in Section 3.5.1.

Salmon Spawning and Redd Protection

The primary means of protecting spawning salmon and redds downstream of the Project are to (1) limit maximum flow levels during spawning to minimize redd building along the edges of the river in areas exposed by daily load following generation and (2) maintain minimum flows throughout the incubation period to keep redds covered until the fry emerge.

Salmon Fry Protection

To minimize and mitigate for potential Project effects on fry stranding, the current Project license requires City Light to limit daily down-ramp amplitude, maintain minimum flows throughout the salmon fry protection period that are adequate to cover gravel bar areas commonly inhabited by salmon fry, and limit down-ramping to nighttime hours except in periods of high flow.

Steelhead Spawning and Redd Protection

Measures to protect spawning steelhead and redds downstream of the Project include limiting maximum flow levels during spawning, shaping daily flows for uniformity over the extended spawning period, and maintaining minimum flows through the incubation period that are sufficient to keep redds covered until fry emerge from the gravel. To protect eggs and embryos from dewatering, the measures in the Revised FSA Flow Plan substantially reduce the difference between spawning and incubation flows, thus decreasing the area of river channel subjected to dewatering.

Steelhead Fry Protection

Newly emerged steelhead fry are protected from potential stranding by limiting daily down-ramp amplitudes and rates and by maintaining minimum flows to cover gravel bar areas commonly inhabited by steelhead fry.

Steelhead and Chinook Salmon Yearling Protection

Down-ramp rates are limited to protect steelhead and Chinook Salmon yearlings.

Other Flow Management Measures

The Revised FSA Flow Plan recognizes that some impacts to anadromous fish spawning, incubation, and rearing may occur notwithstanding the protection measures described above, particularly when uncontrollable flow events occur. In addition to the downstream flow requirements described above, it was recognized that specific voluntary actions may be needed to provide better protection to salmon and steelhead. These voluntary actions are cooperatively developed through the FCC, which considers Project system flexibility, economic ramifications, and potential effects to all anadromous species and life stages at a given time.

Bypass Reach

City Light is not required to release flows for the purpose of creating or maintaining habitat conditions in the bypass reach. As noted previously, however, during maintenance or emergency shutdown periods, water is routed through the bypass reach to maintain instream flow requirements in the Skagit River downstream of Newhalem. NMFS (2012) explains the rationale of interveners when the 1991 Skagit FSA Flow Plan was formulated: "While some historical use of areas upstream from the gorge by steelhead is suggested by anecdotal information gathered at the time of construction (~1927), the preponderance of evidence indicates limited historical anadromous fish use of the Skagit River watershed upstream from the present location of the Gorge powerhouse (Envirosphere 1988). In the 1991 Skagit FSA, intervenors agreed that fish passage and flows in the bypass reach were not needed as long as City Light complied with the provisions of the Skagit FSA, which provides substantial benefits to the river environment downstream from the Gorge powerhouse."

Non-Flow Plan Measures

The current Project license and Settlement Agreement include a number of measures to mitigate for Project effects on off-channel and side channel habitat for fish (FSA Non-flow Plan; License Article 404) and wildlife (WSA; License Article 410). Although the FSA Non-flow Plan was developed prior to the listing of Chinook Salmon, Bull Trout, and steelhead, many of the mitigation measures in the plan benefit at least one of these species.

The FSA Non-Flow Plan includes measures to offset the reduction in off-channel and side-channel habitat, primarily in the 27-mile reach of the Skagit River between Gorge Powerhouse and the Sauk River confluence. The program uses three approaches: protection of existing (functioning) off-channel habitat through acquisition, restoration of existing off-channel habitat, or construction of new off-channel habitat. Nearly three miles of off-channel habitats have been acquired, restored, or built since 1995. Other habitat improvement measures have been implemented in addition to those undertaken to specifically address side channel and off-channel habitats (Table 4.5-18). While focused on improving habitat for Chum Salmon, the program has also benefited other fish species in the Skagit River (i.e., Coho Salmon, Chinook Salmon, steelhead, and Bull Trout) to a lesser degree. While most of the land acquisition and restoration has been accomplished upstream of the Sauk River confluence, the NCC approved the use of some FSA funding to protect or improve aquatic, wetland, and riparian habitat further downstream.

Table 4.5-18. Completed FSA Non-Flow Plan salmon habitat restoration and acquisition projects.

Project	Type	Completion Year	Area of New or Restored Aquatic Habitat (sq. ft)	Land acquisition Area (ac)	Location (RM)
Newhalem Ponds	New channel construction	1991	81,000	NA	90.2
County Line Ponds	New channel construction	1991	22,000	NA	89
County Line Ponds Expansion	Added a pond	1996	730	NA	89
Taylor Channel	New off-channel construction	1998	5,694	NA	79.4

Project	Type	Completion Year	Area of New or Restored Aquatic Habitat (sq. ft)	Land acquisition Area (ac)	Location (RM)
Barnaby Slough Riprap removal	Removal of ~ 1300 CY of riprap from side channel between Skagit River and Lucas Slough	1998	Unknown	NA	70
Johnson Slough	Off-channel habitat acquisition and restoration	2000	7,466	67.5	67.7
Illabot Channel Phase 1 and 2	New off-channel construction	1995/2002	23,207/40,978	NA	74
Powerline Channel	New off-channel construction	2003	27,448	NA	72
Bacon Creek Rip-Rap Removal	Off-channel habitat restoration and floodplain re-connection	2004	792,792	NA	83
Bacon Creek Road Replacement	Rip-rap removal and road replacement	2005	24,000	NA	82
O'Brian Creek Culvert Replacement	Bridge installed to replace undersized culvert	2008	100,000	NA	73
Savage Slough Acqusition[1]	Acquisition of off channel, wetland and upland habitat	2010	NA	211	45
Day Creek Slough (aka Farm and Fowl) Acquisition	Acquisition of upland, off-channel and mainstem habitat	2015	NA	38.4	33
Illabot Creek Channel Restoration[2]	Restoration of natural process and habitat conditions in the alluvial fan	2018	466,092	NA	71
Bogert and Tam Acquisition	Acquisition of upland and off-channel habitat	2018	NA	16.7	73
Barnaby Slough Restoration[2]	Restoration of off-channel habitat	Ongoing	Unknown	NA	70

1 Savage Slough was purchased using a combination of funds from the fish and wildlife license mitigation programs.

2 Primarily funded by Washington State's the Salmon Recovery Funding Board but included some funding from the FSA.

Other Conservation Measures

Following the ESA listing of Chinook Salmon and Bull Trout, City Light implemented the voluntary ESA Early Action Plan (EAP) to fund research, acquire conservation land, and complete habitat restoration projects in the Skagit and Tolt rivers for recovery of listed species. Under this program City Light has purchased and protected over 3,250 acres of high-quality habitat in the Skagit watershed as of 2019. These land purchases have been accomplished using a combination of City Light funds and matching funds and grants from state and federal agencies, tribes, and conservation organizations. The largest of the conservation land acquisitions in the Skagit River Basin is the 1,080-acre Boulder Creek parcel, completed in partnership with The Nature Conservancy (TNC), Washington DNR, and USFWS in 2007. The acquisition protects important migration, spawning, and rearing habitat for Chinook Salmon, steelhead, and Bull Trout in the Cascade River, which is one of the most important areas for ESA-listed fish species in the Skagit River basin.

Habitat restoration work completed under the EAP has focused on the middle Skagit River downstream of the Sauk River confluence, an important Chinook Salmon and steelhead spawning area and a key migration and foraging area for Bull Trout. Restoration work is also accomplished in conjunction with partners in the basin, including agencies, tribes, and conservation groups. Past and ongoing habitat restoration activities include removing invasive species; stabilizing slopes to reduce sediment loads; installing fencing to exclude cattle from riparian areas; planting to revegetate disturbed sites; removing dikes; and replacing under-sized culverts.

4.5.6.2 Proposed Measures

City Light proposes to continue implementing a flow management program to effectively provide mainstem spawning, rearing, and outmigration flows for salmonids in the upper Skagit River downstream of Gorge Powerhouse. City Light also proposes developing an Aquatic Invasive Species Management Plan and will develop additional PME measures when results from relicensing studies are available.

4.6 Botanical Resources

This section describes botanical resources in the Project vicinity. In this section, Project vicinity is defined as the Project structures and reservoirs, transmission line ROW from the powerhouses to Bothell Substation, Gorge bypass reach, Marblemount and Sauk River boat launches, and fish and wildlife mitigation lands in the Skagit, Sauk, and South Fork Nooksack watersheds. See Figure 3.4-28 in Section 3 of this PAD for locations of the fish and wildlife mitigation lands. Botanical resources include: (1) plant communities (vegetation cover types); (2) ESA-listed and other RTE plant species; (3) plant species considered important because of their commercial, recreational, or cultural value; and (4) non-native, invasive plants or “noxious weeds.”

Information provided in this section was summarized from databases, reports, and maps, as well as supporting literature. Publically available aerial imagery (Google Earth 2016) was also reviewed to provide context regarding vegetation cover in areas of the Project Boundary where vegetation mapping has not occurred. Primary sources cited throughout this section include the following:

- Documents and data from NPS (NPS 2007, 2011, 2015).
- Vegetation cover type mapping for the fish and wildlife mitigation lands, completed by City Light (City Light 2006).
- USFWS National Wetlands Inventory (NWI) data for the Project Boundary (USFWS 2019).
- Information from the Whatcom, Skagit, and Snohomish County Noxious Weed Control Boards (Washington State NWCB) (Whatcom County 2019; Skagit County 2018; Snohomish County 2019).
- Washington Natural Heritage Program (WNHP) GIS information for the Project Boundary (WNHP 2018).
- Burke Herbarium Image Collection – Burke Museum (University of Washington 2019).
- Checklist of 1,441 species to occur within North Cascades National Park (NPS 2019a).

4.6.1 Vegetation Cover Types

In general, most of the Project Boundary lies within the Western Hemlock Zone and Pacific Silver Fir Zone of the Northern Cascades Physiographic Province; a portion of the transmission line ROW extends into the Puget Trough Province (Franklin and Dyrness 1988). Much of the area has deeply dissected topography and extremely variable geology and precipitation (Franklin and Dyrness 1988). Forests are primarily mesic to wet and dominated by western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), and western redcedar (*Thuja plicata*). However, in the rain shadow of the Pickett Range near Ross and Diablo lakes, the drier sites support lodgepole pine (*Pinus contorta* var. *latifolia*) and Ponderosa pine (*P. ponderosa*). Common juniper (*Juniperus communis*) and Rocky Mountain juniper (*J. scopulorum*) have also been documented in these areas (University of Washington 2019; NPS 2019a). Deciduous tree species occur in mixed conifer-deciduous stands, in pure stands in early seral situations, and in wetland and riparian habitats. Deciduous shrub species occur in forest edges and understories, avalanche shoots, and wetland communities.

Comprehensive vegetation mapping has been completed for the portion of the Project vicinity within RLNRA, but NPS considers the available data as draft. The vegetation cover on fish and wildlife mitigation lands has been mapped by City Light but using a different classification system than that used by NPS. There is no vegetation cover type map of the transmission line.

4.6.1.1 Project Boundary within RLNRA

NPS has recently mapped vegetation communities for the entire North Cascades National Park Complex, which includes RLNRA (Crawford et al. 2009). Vegetation was classified at the association level and includes data incorporated and reevaluated from previous vegetation studies, as well as new data collected by NPS field mapping crews. The U.S. National Vegetation Classification System (USNVC) defines the association as “a vegetation classification unit defined on the basis of characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy” (Jennings et al. 2009). Alliances reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes (Crawford et al. 2009). The final classification evaluated 2,479 legacy plots and 917 new classification plots throughout the North Cascades National Park Complex (Crawford et al. 2009). This recent study resulted in a total of 311 upland and forested wetland associations and is the most comprehensive vegetation data currently available for RLNRA. However, it can be assumed that many fewer associations are located within the portion of the NPS mapping that is directly within the Project Boundary.

Although the NPS study described and classified vegetation throughout the North Cascades National Park Complex at the association level, the draft GIS data from the study are mapped at the alliance level, which is the mapping standard for NPS projects. The alliance level (7th level hierarchy) is a slightly broader classification system and contains one or more associations (8th level hierarchy). The USNVC defines the alliance as “a vegetation classification unit containing one or more associations, and defined by a characteristic range of species composition, habitat conditions, physiognomy, and diagnostic species, typically at least one of which is found in the uppermost or dominant stratum of the vegetation” (Jennings et al. 2009). Alliances reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes (Crawford et al. 2009). Of the approximately 20,220 acres of the portion of the Project Boundary that is within RLNRA, approximately 13,170 acres (65 percent) are mapped as flowing or impounded water. Terrestrial vegetation alliances and their cover types mapped within RLNRA portion of the Project Boundary are summarized in Table 4.6-1. Background information and the methods of the classification project, as well as the available descriptions of the vegetation alliances, are appended to this PAD.

Table 4.6-1. Terrestrial vegetation alliances within the portion of the Project Boundary within RLNRA.

Alliance Code	Alliance Name	Acreage within Project Boundary	Percent of Project Boundary
Forested Uplands			
M07	Warm Silver Fir Western Hemlock Forest	46.2	0.7
M19	Big Leaf Maple Debris Apron Forest	40.0	0.6
M20I	Upland Deciduous Forest	514.4	7.3
M33	Douglas-fir Subalpine Fir Woodland	146.4	2.1
M35	Lodgepole Pine Douglas-fir Forest	443.7	6.3
M36	Ponderosa Pine Douglas-fir Forest	1.9	0.2
M42	Mesic Western Hemlock Douglas-fir Forest	1,100.4	15.6
M43E	Dry Western Hemlock Douglas-fir Forest	1,860.6	26.4
M46A	Silver Fir Mountain Hemlock Forest A	0.5	<0.1
Forested Uplands Total		*4,154.1*	*59.2*
Non-forested Uplands			
M18	Vine Maple Shrubland	73.3	1.0
M21	Sitka Alder Shrubland	1.0	<0.1
M50	Talus Sparse Shrubland and Woodland	832.9	11.8
M51	Dry Tall Shrubland	5.0	0.1
M61	Mesic Tall Forb and Thimbleberry Meadow	10.0	0.1
Non-forested Uplands Total		*922.2*	*13.0*
Sparsely Vegetated Uplands			
M66	Vegetated Bald	144.2	2.0
M90	Alluvial Barren	51.6	0.7
M91	Colluvial Barren	101.9	1.4
M93	Bedrock Barren	27.7	0.4
Sparsely Vegetated Uplands Total		*325.4*	*4.5*
Forested Wetlands			
M01	Deciduous Floodplain and Swamp Forest	204.2	2.9
M01Y	Gravel Bar Deciduous Floodplain Forest	160.8	2.3
M44	Wet Western Hemlock Douglas-fir Forest	839.2	11.9
Forested Wetland Total		*1,204.2*	*17.1*
Non-Forested Wetlands			
M39H	Lowland Wet Meadow	191.1	2.3
M39S	Lowland Wet Shrubland	253.2	3.6
Non-Forested Wetlands Total		*444.3*	*5.9*
Grand Total		7,050.2 acres	

Source: Crawford et al. 2009.

Upland Habitat Types

Upland habitats make up approximately 5,402 acres (77 percent) of the terrestrial portion of the Project Boundary within RLNRA. Upland habitats are mostly forested (77 percent), with the Dry Western Hemlock Douglas-fir Forest the most dominant vegetation type within the Project Boundary in RLNRA (Table 4.6-1).

In the North Cascades National Park Complex, plant communities are roughly distributed in an east-west gradient reflecting the wetter, maritime-influenced climate on western slopes; cold temperatures and persistent snow at high elevations; and a drier, continental climate in the rainshadow on the eastern slopes. The Cascade Range is so wide that the rainshadow begins west of the Cascade divide (Agee and Kertis 1987). Specifically, west-side vegetation is characterized by Western Hemlock–Western Redcedar–Douglas-fir forests at low elevations, Pacific Silver Fir (*Abies amabilis*) forests at mid-elevations, and Mountain Hemlock (*Tsuga mertensiana*) at treeline. Dwarf shrublands, consisting primarily of heather, and sparsely vegetated alpine rocklands occur above treeline (Douglas and Bliss 1977). Eastside vegetation includes Ponderosa Pine– Douglas-fir in the dry, southeast portion of the park, Douglas-fir–Lodgepole Pine–Grand Fir (*Abies grandis*) forests at lower elevations, and Subalpine Fir (*Abies lasiocarpa*), Whitebark Pine (*Pinus albicaulis*) or Subalpine Larch (*Larix lyallii*) at treeline. The Ross Lake area is unique due to the juxtaposition of eastern and western vegetation patterns on north versus south aspects (Hoffman et al. 2015, Agee and Kertis 1987).

Generally, Dry-Western Hemlock Douglas-fir forest is dominant on the east side of Ross Lake with some Mesic Western Hemlock-Douglas-fir Forest near the confluences of Hozomeen Creek, Lightning Creek, and the south side of Ruby Arm. Mesic Western Hemlock Forest is also dominant at the lower elevations on the west side of the reservoir with a transition to Silver Fir-Mountain Hemlock Forest as the elevation increases. Uplands mapped in this area are predominantly Lodgepole Pine-Douglas-fir Forest.

The majority of land around Diablo Lake is dominated by Mesic Western Hemlock-Douglas-fir Forest mixed with Lodgepole Pine-Douglas-fir Forest. The exception is the eastern portion of the Diablo Arm where Dry Western Hemlock-Douglas-fir Forest is dominant.

Upper portions of Gorge Lake are dominated by Lodgepole Pine-Douglas-for Forest interspersed with some Talus Sparse Shrubland and Woodland on the north bank and Mesic Western Hemlock-Douglas-fir Forest on the southern bank. Lower portions of Gorge Lake are dominated by a mix of Talus Sparse Shrubland and Woodland and Upland Deciduous Forest at lower gradients on both banks that transitions to Colluvial Barren and Bedrock Barren as it moves up gradient.

The townsites of Newhalem and Diablo are mapped as a mix of Alluvial Barren, Gravel Bar Deciduous Floodplain, and Talus Sparse Shrubland and Woodland. However, this appears to be an error in the mapping as the majority of the townsites are developed and landscaped.

Based on the 2009 NPS vegetation mapping study, vegetation in the 20 miles of transmission line corridor within RLNRA is dominated by Upland Deciduous Forest interspersed with Dry Western Hemlock Douglas-fir Forest (Crawford et al. 2009). However, the majority of this area is managed to be kept in early seral stages or shrubs. Based on the aerial imagery (Google Earth 2016), in upper elevations of the corridor within RLNRA, the transmission towers are often located on sparsely vegetated balds and talus slopes. Vegetation management in these areas follows guidelines of the Washington Park Wilderness Act of 1964 (Public Law 88-577) in addition to NERC requirements. These management guidelines are followed by City Light's Skagit Vegetation Management Crew and extend outside of RLNRA to just east of the Sauk River confluence. The primary invasive species along the transmission line within RLNRA include Himalayan blackberry (*Rubus armeniacus*), old man's beard (*Clematis vitalba*), common tansy (*Tanacetum vulgare*), and Scot's broom (*Cytisus scoparius*). Invasive species and vegetation management throughout the Project Boundary are discussed further in Sections 4.6.3 and 4.6.4 of this PAD, respectively.

Wetlands, Riparian, and Littoral

Wetlands

Wetlands are transitional lands that occur between uplands and aquatic systems. Areas of deep, permanent water are not included under the definition of wetland. Ponds, swamps, marshes, bogs, springs, fens, and wet meadows are examples of wetlands. Within a federal regulatory context, wetlands are those habitats that exhibit hydrophytic vegetation, hydric soil characteristics, and wetland hydrology (Environmental Laboratory 1987). The vegetation classification scheme used by NPS does not specifically map wetlands. Some vegetation associations may include wetlands and/or a combination of wetland, riparian, and upland habitats and therefore, it is not known if all the cover types in this mapped by NPS meet the regularly definition.

Plant cover types that include vegetation associations with wetlands or a combination of wetlands and other habitats, comprise approximately 1,647 acres (23 percent) of the Project Boundary within RLNRA (Table 4.6-1). These cover types are dominated by forested wetlands, which cover 73 percent of all mapped wetland cover types, respectively.

Most of the wetland cover types mapped by NPS in the Project Boundary within RLNRA are associated with Ross Lake. The largest of these is in the Big Beaver Drainage and is composed of primarily Wet Western Hemlock Douglas fir Forest and Lowland Wet Shrubland, interspersed with Lowland Wet Meadow and Deciduous Floodplain and Swamp Forest. Additional forested wetland cover types occur within the various drainages that flow into the Project Boundary (e.g., Silver, Hozomeen, Arctic, Gorge, Newhalem creeks) as well as narrow fringe areas along the banks of the three reservoirs. A second, smaller wetland complex is mapped near the outlet of Thunder Creek and is dominated by Wet Western Hemlock-Douglas fir Forest. Small patches of non-forested wetland are mapped near the U.S.-Canada border.

Based on the aerial imagery, a large forested- and non-forested wetland complex also occurs outside of the Project Boundary and north of the U.S.-Canada border, at the north end of Ross Lake (Figure 4.6-1). Approximately 250 acres in this area are composed of a mixture of emergent wetland and shallow littoral lacustrine habitat. Almost all of this complex is in Canada and thus not included in the NPS mapping. This wetland is composed of a mixture of native grasses and sedges although there are also some patches of non-native reed canary grass. Elsewhere along Ross Lake, NPS has also documented small no-forested wetland patches in protected inlets at Little Beaver Creek, Big Beaver Creek, Dry Creek, and Roland Point. These wetlands also have reed canarygrass at varying densities (Figure 4.6-2). During 2019, when Ross Lake water levels were unusually low, NPS noted more reed canarygrass establishment in the exposed drawdown zone

(Bivin 2019). One extensive scrub-shrub/emergent wetland occurs near the mouth of Thunder Creek on Diablo Lake. At Gorge Lake, there are patches of scrub-shrub and emergent wetland between the Gorge Campground and the SR 20 bridge.

Between Newhalem and the boundary of RLNRA near Bacon Creek, there are a many small seeps (slope wetlands) along the riverbanks. There are two large wetland complexes at the Newhalem Ponds and County Line Ponds fish habitat areas. These complexes consist of open water, aquatic bed, emergent, scrub-shrub, and forested wetland zones.

Figure 4.6-1. Wetland in Canada located on the north end of Ross Lake (looking south).

Figure 4.6-2. Reed canary grass along Ross Lake.

Washington DNR also maps Wetlands of High Conservation Value (WHCV) as part of the WNHP. These wetlands have been identified by the WNHP as either high quality undisturbed wetlands or wetlands that support rare or sensitive plant populations (Hruby 2014). Mapped locations of WHCVs are on a broad scale and exact locations would need to be verified in the field.

Two WHCVs are mapped near the Ross Lake confluence of the Big Beaver Drainage. One is mapped as a North Pacific Lowland Floodplain Forest containing the Red alder (*Alnus rubra*)/Salmonberry (*Rubus spectabilis*) plant association. The second is a Vancouverian Headwater Riparian Shrubland containing the Vine Maple (*Acer circinatum*) Wet Shrubland plant association. Four other WHVCs are mapped as occurring within the Big Beaver Drainage and within the Project Boundary. However, these are approximately two miles upstream from the Ross Lake confluence and are not influenced by the current hydrology of Ross Lake. Information on these and other WHVCs mapped within RLNRA, within the Project Boundary, are included in Table 4.6-2.

Table 4.6-2 WHCVs mapped as occurring within the Project Boundary within RLNRA.

Location	Location within Project Boundary	Wetland Type	Plant Association
S4 T38N R13E	Lower Big Beaver Drainage	North Pacific Lowland Floodplain Forest	Red alder/Salmonberry
S4 T38N R13E	Low Big Beaver Drainage	Vancouverian Headwater Riparian Shrubland	Vine Maple Wet Shrubland
S4 T38N R13E	Upper Big Beaver Drainage	Vancouverian Headwater Shrubland	Green alder/Vine maple shrubland
S4 T38N R13E	Upper Big Beaver Drainage	North Pacific Conifer Seepage Swamp	Western hemlock–Douglas fir/devil's club)/sword fern swamp forest
S4 T38N R13E	Upper Big Beaver Drainage	North Pacific Conifer Basin Swamp	Western red cedar–Western hemlock/skunk cabbage
S4 T38N R13E	Upper Big Beaver Drainage	North Pacific Conifer Seepage Swamp	Pacific fir/Devil's club

No WHCVs are mapped as occurring along the transmission line within the RLNRA or along Diablo or Gorge lakes.

Riparian Habitat

Agencies, scientific literature, and non-peer reviewed publications often have variable definitions of riparian habitat. In general, however, riparian habitat is defined as the interface between land and watercourses and is unique due to soil and vegetation characteristics that are influenced by the presence of water. Riparian habitats provide important ecosystems functions such as nutrient cycling, water quality, flood storage, habitat, and refuge (NRCS 1996).

Many of the creeks that flow into Ross Lake (e.g., Little Beaver, Lightning, Arctic, Devil's creeks) are within narrow, rocky and steep drainages and the adjacent vegetation is not significantly influenced by the presence of water. Most are bordered by areas mapped as a mix of upland vegetation dominated Mesic Western Hemlock Douglas-fir Forest and Dry Western Hemlock Douglas-fir Forest. Drainages that exhibit a higher gradient (e.g., Devil's and Lightning creeks) often include a Talus Sparse Shrubland and Woodland component. Big Beaver Creek, which follows a lower gradient and supports a large wetland complex, as described above. Where this wetland complex transitions to upland near the toe of the valley slope, vegetation is primarily mapped as Mesic Western Hemlock Douglas-fir Forest and Dry Western Hemlock Douglas-fir Forest to the north and Talus Sparse Shrubland and Woodland to the south.

Riparian vegetation mapped along eight streams that flow into Diablo Lake (e.g., Colonial, Rhode, and Deer creeks) is similar to the alliances mapped along Ross Lake, and primarily exhibit a mixture of Mesic Western Hemlock Douglas-fir Forest and Dry Western Hemlock Douglas-fir Forest with some areas of Talus Sparse Shrubland and Woodland. The exception is Thunder Creek, which as described above, contains a wetland complex dominated by Wet Western Hemlock-Douglas-fir Forest.

Riparian vegetation mapped along six streams flowing into Gorge Lake (e.g., Pyramid, Stetattle, and Gorge creeks) exhibit the Talus Sparse Shrubland and Woodland alliance. Forested cover, where present, is dominated by Upland Deciduous Forest.

The Skagit River within the RLNRA from Gorge Dam to Newhalem is mostly outside the Project Boundary except where it intersects the transmission line ROWs. This section of the river is within a narrow, rocky channel and the adjacent area is dominated by Talus Sparse Shrubland and Woodland. At Newhalem the river channel widens somewhat and the associated vegetation transitions to Upland Deciduous Forest. This continues to be the dominant cover type along the Skagit River downstream within the RLNRA due to the confined form of the river channel. Much of the reach downstream of Bacon Creek is outside of the transmission line corridor and, therefore, outside the Project Boundary. Riparian/wetland areas along this reach are dominated by Wet Western Hemlock Douglas-fir Forest. The transmission line portion of the Project Boundary within the RLNRA crosses approximately 20 streams. Major stream crossings include Goodell Creek, Babcock Creek, Thornton Creek, Sky Creek, Damnation Creek, Bacon Creek, and Diobsud Creek.

A University of Idaho study (Casey 2006) assessed black cottonwood (*Populus trichocarpa*) and willow (*Salix* spp.) recruitment on suitable point bars, islands, and side bars along the upper Skagit (Newhalem-Marblemount), mid-Skagit (Marblemount-Sauk River), lower Skagit (Sauk River-Sedro-Woolley) reaches of the Skagit River, along with the upper Sauk River (above the Whitechuck River), and lower Sauk (Suiattle River to Skagit River). Although sample sizes were not large, the main findings of the research included the following:

- Relative cover of late successional tree species including *Abies grandis*, *Acer macrophyllum*, *Pseudotsuga menziesii*, *Taxus brevifolia*, *Thuja plicata*, and *Tsuga heterophylla* was higher in the uppermost reach of the Skagit.
- The number of shrub species in plots was similar in the Skagit River reaches but lower on the Sauk River.
- The upper Skagit reach had more mature cottonwood and alder than juvenile age classes, whereas the Sauk River had more juvenile than mature trees. In the mid-Skagit reach, there were more juvenile cottonwood than red alder. Salix seedlings were more abundant than cottonwood seedlings in the mid-Skagit, and upper and lower Sauk reaches, yet less abundant than cottonwoods on the upper Skagit and lower Skagit reaches. The Sauk River had more than two times as many willow seedlings as the Skagit River.
- The number of exotic forb species recorded in the upper Skagit and the two Sauk reaches was low compared to the mid- and lower Skagit. Native forbs accounted for 81 percent of the herbaceous species in the upper Skagit, 59 percent in the mid-Skagit, and 86 percent in the lower Skagit. In the Sauk, the native forbs accounted for 78 percent of the species in the upper and 98 percent in the lower reach.
- More cottonwoods were found in the upper Skagit and upper Sauk reaches than the mid-Skagit and lower Sauk reaches.
- Overall trends in seedling elevation distribution were consistent for all three major riparian

tree species—cottowood, willow, and alder. About 75 percent of cottonwood seedlings sampled along the Skagit upriver of the Sauk were located at elevations less than 50 cm above mean base flow, whereas on the Sauk River, only 11 percent of seedlings were below 50 cm above base flow elevation. The majority (70 percent) of seedlings on the Sauk River were found from 51-150 cm above mean base flow water level. The lower Skagit reach sampling sites had 60 percent of seedlings in 0-50 cm relative elevation zone. On the mid-Skagit reach, 90 percent of willow seedlings were found below the 50 cm elevation. In contrast, on the Sauk River, less than 10 percent of willow seedlings were in this zone.

- On the mid-Skagit reach, cottonwoods were older than other reaches. The following is a summary of age classes on each reach:
  - Upper Skagit: Six age classes – 5, 14, 17, 20, 23 and 65 years
  - Mid-Skagit: Fourteen age classes – 2, 5, 8, 11, 14, 17, 20, 23, 26, 44, 56, 59, 65 and 70+ years.
  - Lower Skagit: Eleven age classes – 5, 8, 11, 14, 17, 20, 23, 26, 29, 35 and 44 years.
  - Lower Sauk: Seven age classes – 5, 8, 11, 14, 17, 20 and 26 years.
- Cottonwood recruitment/establishment conditions were found to be favorable in 15 of 22 years in the upper Skagit versus 11 of 22 years in the lower Skagit, with the lower value in the lower Skagit due primarily to the larger scouring events there. However, cottonwood recruitment in the reach just downriver of the dam is reduced due to lower peak flows, altered timing of annual peak flows, and reduced availability of finer sediment. Augmentation of summer flows reduces drought mortality of seedlings and reduction of vegetation scouring flows partially offsets the lower recruitment.

Lacustrine/Littoral Habitat

Lacustrine habitat includes deep water habitats of lakes and ponds. Littoral habitat is generally defined as the shallow margins of lakes less than two meters deep.

4.6.1.2 Transmission Line Corridor Outside of the RLNRA

Upland Habitat Types

Outside of the RLNRA, the nearly 73 miles of transmission line corridor is generally dominated by a mixture of lower elevation herbaceous species, shrubs, and trees (Figure 4.6-3). Common examples include red alder, cascara (*Frangula purshiana*), beaked hazelnut (*Corylus cornuta*), bitter cherry (*Prunus emarginata*), western red-osier dogwood (*Cornus occidentalis*), salal (*Gaultheria shallon*), and roses (*Rosa sp*.). These species are primarily Himalayan blackberry, old man's beard, common tansy, and Scot's broom. Near its southern terminus, the transmission line crosses several agricultural fields within the Snohomish River Valley that are dominated by maintained agronomic grasses. More information on City Light's vegetation management throughout the Project Boundary is included in Section 4.6.4 of this PAD.

Figure 4.6-3 Transmission line corridor southwest of Illabot Creek, looking northwest, 2011.

Wetlands, Riparian, and Littoral Habitats

Wetlands

USFWS NWI maps approximately 69.4 acres of wetland within the transmission line corridor, outside of the RLNRA. Of this, 39.9 acres (57 percent) are mapped as Freshwater Forested/Shrub Wetland and occur in lower elevations in wetland complexes associated with Quilceda Creek and Lake Cassidy in Snohomish County. The remaining 29.5 acres (43 percent) are mapped as Freshwater Emergent Wetlands, and primarily occur in agricultural fields within the Snohomish River Valley.

The WNHP indicates several areas of WHCV within and in the vicinity of the transmission line corridor outside of the RLNRA (Table 4.6-3). As mentioned above, mapped locations of WHCVs are on a broad scale and exact locations would need to be verified in the field. Additional information on sensitive plants in these wetlands is provided in Section 4.6.6 of this PAD.

Table 4.6-3. WHCVs mapped near the transmission line corridor outside of the RLNRA.

Location	Approximate Distance from Project Boundary (PB)	Type(s)	Plant Associations
S12 T34N R9E	Within PB 0.9 mile northeast of Sauk River Crossing	North Pacific Conifer Basin Swamp	Western redcedar/western hemlock/swamp cabbage forest
		North Pacific Transitional Poor Fen	Douglas' spirea/Sitka sedge fen
S31 T34N R10E	Immediately adjacent to PB 1.4 miles north of Sauk River Crossing	North Pacific Open Flat Bog	Bog Labrador tea/bog laurel/sphagnum bog
		North Pacific Conifer Seepage Swamp	Western redcedar/western hemlock/swamp cabbage forest
S8 T33N R10E	On the east side of the Sauk River 3.4 miles south of the Sauk Crossing	North Pacific Lowland Floodplain Forest	Black cottonwood-red alder/salmonberry riparian forest

Location	Approximate Distance from Project Boundary (PB)	Type(s)	Plant Associations
S7 T31N R7E	1.7 miles SE of Jim Creek crossing	North Pacific Freshwater Aquatic Vegetation	Buckbean (Menyanthes trifoliate) aquatic vegetation
		Vancouverian Lowland Basin Marsh	Equisetum fluviatile Pacific coast marsh
		North Pacific Lowland Intermediate Fen	Carex aquatilus – Comarum palustre fen
		Vancouverian Perrenial Riparian Shrubland	Douglas' spirea wet shrubland
		Vancouverian Shrub Basin Swamp	Malus fusca shrub swamp
S25 T30N R5E	Within PB at Catharine Creek crossing	North Pacific Bog Woodland	Lodgepole pine/bog Labrador tea/sphagnum treed bog
		North Pacific Open Flat Bog	White beaked sedge/sphagnum fen

Source: Washington DNR WNHP 2019.

Riparian Habitat

Outside of the RLNRA, the transmission line crosses approximately 146 mapped stream crossings (Washington DNR 2019). Major crossings include the Skagit, Sauk, South Fork Stillaguamish, and Snohomish rivers. The transmission lines cross the Skagit River near the confluence of Corkindale Creek, just downstream of Marblemount. Based on an analysis of aerial imagery, vegetation on the right bank at the Skagit River crossing ("Corkindale Crossing") is heavily modified and primarily mowed lawn or agricultural fields. A narrow band of shrubs, probably willows (*Salix* sp.), occur along the bank. The left bank at this crossing is part of the Illabot North fish and wildlife mitigation land parcel and appears to be covered by native shrubs and deciduous trees along the bank. Additionally, there appear to be some Himalayan blackberry and clematis along the access road to this area.

The riparian vegetation at the Sauk River and South Fork Stillaguamish River crossings appears to be intact with native vegetation, dominated by a mix of deciduous and coniferous trees. Maintained lawn associated with a residence along the north side of the South Fork Stillaguamish is present within the transmission line corridor, approximately 200 feet from the right bank.

Vegetation at the Snohomish River crossing is highly modified and appears to be largely Himalayan blackberry along the right bank and maintained lawn or fields along the left bank. Lawn and field maintenance is likely performed by private land owners of the agricultural fields in these areas.

Lacustrine/Littoral Habitat

Based on an analysis of aerial imagery, the transmission line corridor does not cross any lakes or lacustrine habitat, outside the RLNRA. The corridor is adjacent to several lakes, primarily in lower elevations. These include Forston Ponds, and Riley, Olson, and Martha Lakes, all located within Snohomish County.

4.6.1.3 Fish and Wildlife Mitigation Lands

As described in Section 3.4.10 of this PAD, under the current Project license, City Light was required to spend $17 million (1990$) for the acquisition and management of fish and wildlife mitigation lands in and near the Skagit River basin. As of 2003, City Light had acquired 14 parcels, totaling over 8,300 acres of land within the South Fork Nooksack, Sauk, and Skagit watersheds. As part of the development of the Skagit Wildlife Mitigation Plan (City Light 2006), a GIS analysis of vegetation cover was performed for each wildlife mitigation land parcel. The study did not include an analysis of the parcels in the Fish Program (County Line Ponds, Day Creek Slough, Johnson, and Newhalem Ponds). An analysis of results of this study are summarized in the subsections below, organized by upland, wetland, riparian, and littoral habitat types and by basin. City Light mapped the vegetation on the fish and wildlife mitigation lands using a different mapping classification scheme than used by NPS for the RLNRA. The evaluation of conditions was done between 2001 and 2003 and focused on seral stage and structures. Site conditions will likely change over time and require further site evaluation (City Light 2006).

Between 2004 and 2019, City Light acquired approximately 2,550 acres of additional parcels that that are being managed as fish and wildlife mitigation lands. The Project Boundary currently on file with FERC was approved in 2013 and includes some of the newly acquired lands but it does not include more recently acquired lands or the 132 acres in the South Fork Nooksack watershed that were exchanged for 350 acres. Currently, City Light owns a total of approximately 10,850 acres of fish and wildlife mitigation lands. See Figure 3.4-28 in Section 3 of this PAD for locations of the current fish and wildlife mitigation lands. A GIS vegetation analysis has not been performed on the parcels acquired since the 2006 study and are therefore not included in the descriptions below. GIS analysis of the habitat types within all fish and wildlife mitigation lands will be completed as part of the relicensing process.

Upland Habitat Types

Upland habitats and approximate acreages for each of the fish and wildlife mitigation lands, separated by basin, are summarized in Tables 4.6-4 through 4.6-6.

Table 4.6-4. Upland habitat types in the fish and wildlife mitigation parcels in the South Fork Nooksack River basin.

Upland Habitat Type	Parcel		Total
	Bear Lake	South Fork Nooksack	
Upland Conifer Forest			
Clearcut		10.6	11
Early seral (seedlings)		8.5	9
Early seral conifer		314.2	314
Mid seral conifer		783.3	783
Late seral conifer - mature		10.2	10
Late seral conifer - old-growth	153.0	455.8	609
Open mature		34.6	35

Upland Habitat Type	Parcel		Total
	Bear Lake	South Fork Nooksack	
Total	153.0	1,617.2	1,770
Upland Hardwood Forest			
Early seral hardwood		147.1	147
Mid seral hardwood		673.1	673
Late seral hardwood		102.2	102
Total	0	922.4	922
Upland Mixed Forest (Hardwood/Conifer)			
Early seral mixed		68.4	68
Mid seral mixed		996.0	996
Total	0	1,064.4	1,064
Upland Non-Forested			
Shrubfields		0.1	0
Exposed rock		2.0	2
Landslide		9.9	10
Total	0	12.0	12
Grand Total	**153**	**3,616**	**3,769**

Source: City Light 2006.

Table 4.6-5. Upland habitat types in the fish and wildlife mitigation parcels in the Sauk River basin.

Upland Habitat Type	Parcel					Total
	Dan Creek	Everett Creek	N. Everett Creek	North Sauk	Sauk Island	
Upland Conifer Forest						
Mid seral conifer	0.1					0
Total	0.1	0	0	0	0	0
Upland Hardwood Forest						
Mid seral hardwood		25.6	14.8			40.4
Total	0	25.6	14.8	0	0	40
Upland Mixed Forest (Hardwood/Conifer)						
Mid seral mixed hardwood/conifer	18.8	15.5				34.3
Total	18.8	15.5	0	0	0	34
Upland Non-Forested						
Disturbed site		1.8	3.3	7.3		12.4
Total	0	1.8	3.3	7.3	0	12
Grand Total	**19**	**43**	**18**	**7**	**0**	**87**

Source: City Light 2006.

Table 4.6-6. Upland habitat types in the fish and wildlife mitigation parcels in the Skagit River basin.

Upland Habitat Type	Parcel							Total
	Barnaby	Illabot N	Illabot S	Lucas	McLeod	Napoleon	Bacon	
Upland Conifer Forest								
Clearcut			575.7	4.7	0.8			
Clearcut (partial)			112.0					
Recent burn			27.0					
Early seral	3.3							
Early seral conifer	17.9		588.8					
Mid seral conifer	24.8	360.8	529.7				40.6	
Late seral conifer old-growth			66.7					
Total	45.9	360.8	1,899.9	4.7	0.8	0	40.6	2,353
Upland Hardwood Forest								
Early seral hardwood		14.1	32.3					
Mid seral hardwood	0.4	14.5	90.7	112.6	2.9			
Late seral hardwood		119.2	28.7	35.4	13.3	5.4		
Total	0.4	147.8	151.7	148.0	16.2	5.4	0	470
Upland Mixed Forest (hardwood/conifer)								
Early seral mixed		73.7	199.7			2.4		
Mid seral mixed	99.8	74.0	73.8		0.2	14.7		
Total	99.8	147.7	273.5	0	0.2	17.1	0	538
Upland Non-Forest								
Managed shrub grassland		25.3	4.6		54.3		0.9	
Exposed rock			0.6				2.6	
Disturbed site	1.5	5.3	1.4	0.3			11.4	
Total	1.5	30.6	6.6	0.3	54.3	0	14.9	108
Grand Total	**147.6**	**686.9**	**2,265**	**153**	**71.5**	**22.5**	**55.5**	**3,469**

Source: City Light 2006.

Wetlands, Riparian, and Littoral Habitats

Wetlands

Wetland habitats and approximate acreages for each of the fish and wildlife mitigation lands, separated by basin, are summarized in Tables 4.6-7 through 4.6-9.

Table 4.6-7. Wetland habitat cover in the fish and wildlife mitigation parcels in the South Fork Nooksack River basin.

Wetland Type	Parcel		Total
	Bear Lake	S. Fork Nooksack	
Emergent wetland		1.4	1.4
Shrub wetland		10.1	10.1
Total	**0**	**11.5**	**12**

Source: City Light 2006.

Table 4.6-8. Wetland habitat cover in the fish and wildlife mitigation parcels in the Sauk River basin.

Wetland Type	Parcel					Total
	Dan Creek	Everett Creek	N. Everett Creek	North Sauk	Sauk Island	
Emergent wetland				2.6		0
Shrub wetland		10.3	10.2	0.2		
Broadleaf wetland	5.5					
Total	**5.5**	**10.3**	**10.2**	**2.8**	**0**	**29**

Source: City Light 2006.

Table 4.6-9. Wetland habitat cover in the fish and wildlife mitigation parcels in the Skagit River basin.

Wetland Type	Parcel							Total
	Barnaby	Illabot N	Illabot S	Lucas	McLeod	Napoleon	Bacon	
Emergent wetland	26.0	3.8		15.2				45.0
Shrub wetland		31.4		34.0	8.7	3.2		77.3
Broadleaf wetland			0.2					0.2
Total	**26.0**	**35.2**	**0.2**	**49.2**	**8.7**	**3.2**	**0**	**123**

Source: City Light 2006.

Additionally, NWI maps a total of approximately 290 acres of wetlands across all fish and wildlife mitigation parcels. In total, 254 acres (88 percent) of the mapped wetlands are Freshwater Forested/Shrub Wetlands, with the majority occurring in the Skagit Parcel Group including the McLeod, Napoleon Slough, Lucas Slough, and Illabot North Parcels. Several smaller Freshwater Forested/Shrub Wetlands are mapped along the South Fork Nooksack River within the Nooksack parcel, as well as along the Sauk River within the North Sauk, Everett Creek, and North Everett Creek parcels. The remaining 36 acres mapped by NWI are Freshwater Emergent Wetlands and occur within the Barnaby Slough and Bear Lake parcels.

The WNHP indicates several areas of WHCV within and in the vicinity of the fish and wildlife mitigation lands. A summary of the mapped WHCVs near the fish and wildlife mitigation lands is presented in Table 4.6-10. Additional information on sensitive plants in these wetlands is provided in Section 4.6.6 of this PAD.

Table 4.6-10. Mapped WHCVs near the fish and wildlife mitigation lands.

Location	Approximated distance from fish and wildlife mitigation lands	Type(s)	Vegetation Association
S36 T35N R10E	Immediately adjacent to SE corner of Illabot South	North Pacific Conifer Seepage Swamp	Tsuga mertensiana - Abies amabilis / Caltha leptosepala ssp. howellii Swamp Forest
S22 T35N R10E	Immediately adjacent to NE corner of Illabot North	North Pacific Lowland Floodplain Forest	Populus balsamifera ssp. trichocarpa - Acer macrophyllum / Symphoricarpos albus Riparian Forest
S6 T36N R7E	Within Bear Lake parcel	Vancouverian Montane Basin Marsh and Wet Meadow	Carex lenticularis var. lipocarpa Marsh
S5 T36N R7E	One mile north of Nooksack parcel	Vancouverian Montane Basin Marsh and Wet Meadow	Carex lenticularis var. lipocarpa Marsh
		Alpine-Subalpine Seep and Spring	Carex nigricans Wet Meadow

Beaver activity on several of the fish and wildlife mitigation lands has contributed to wetland diversity. Beaver dens have been observed on the Newhalem Pond, County Line Pond, Illabot North, Barnaby Slough (upper Harrison Slough), Lucas Slough, Napoleon Slough, McLeod, South Fork Nooksack, and Savage Slough parcels (Tressler 2019).

Riparian Habitat

Riparian habitats and approximate acreages for each of the fish and wildlife mitigation lands, separated by basin, are summarized in Tables 4.6-11 through 4.6-13.

Table 4.6-11. Riparian habitat cover in the fish and wildlife mitigation parcels in the South Fork Nooksack River basin.

Riparian Habitat Type	Parcel		Total
	Bear Lake	South Fork Nooksack	
Riparian shrub		8.2	8.2
Riparian forest hardwood		16.7	16.7
Total	**0**	**24.9**	**25**

Source: City Light 2006.

Table 4.6-12. Riparian habitat cover in the fish and wildlife mitigation parcels in the Sauk River basin.

Riparian Habitat Type	Parcel					Total
	Dan Creek	Everett Creek	N. Everett Creek	North Sauk	Sauk Island	
Riparian shrub			1.7		1.4	3.1
Riparian forest hardwood	9.3	14.3	1.2	36.7	27.4	88.9
Riparian forest mixed		72.1	36.9			109.0
Riparian forest conifer	6.6				7.0	13.6
Total	**15.9**	**86.4**	**39.8**	**36.7**	**35.8**	**215**

Source: City Light 2006.

Table 4.6-13. Riparian habitat cover in the fish and wildlife mitigation parcels in the Skagit River basin.

Riparian Habitat Type	Parcel							Total
	Barnaby	Illabot N	Illabot S	Lucas	McLeod	Napoleon	Bacon	
Riparian forest hardwood					45.3	10.6		55.9
Riparian forest mixed	25.9	20.7	40.3			27.0	49.3	163.2
Riparian forest conifer			128.7					128.7
Total	**25.9**	**20.7**	**169.0**	**0**	**45.3**	**37.6**	**49.3**	**348**

Source: City Light 2006.

Currently, the fish and wildlife mitigation lands include 87.4 miles of mapped streams. Many of the streams on these parcels are smaller streams with narrow riparian corridors that could be difficult to map using a GIS analysis. Table 4.6-14 below summarizes the linear feet of stream channel on each parcel, separated by basin. This information includes the current land holdings, including the parcels acquired since the 2006 study.

Table 4.6-14. Miles of stream channel within fish and wildlife mitigation parcels.

Parcel	Miles of Stream
South Fork Nooksack River Basin	
Bear Lake	0.61
Nooksack	39.1
Nooksack West	5.5
Total	**45.2**
Sauk River Basin	
Dan Creek	0.3
Everett Creek	0.2
North Everett Creek	1.3
North Sauk	0.6
Total	**2.5**
Skagit River Basin	
Savage Slough	1.5
County Line Ponds	1.2
Day Creek Slough	0.2
Johnson	0.7
Newhalem Ponds	0.4
B&W Road 1	0.3
B&W Road 2	0.2
Bacon Creek	1.1
Barnaby Slough	1.8
Finney Creek	7.7
Illabot North	3.3
Illabot South	13.1
Lucas Slough	1.6
McLeod	1.1
Napolean Slough	0.5
O'Brien Slough	0.5
Pressentin	3.7
South Marble 40	0.3
Corkindale Creek	0.6
Total	**39.7**
Grand Total	**87.4**

Lacustrine/Littoral Habitat

Within the South Fork Nooksack Parcel Group, the Bear Lake parcel is the only fish and wildlife mitigation lands to have lacustrine habitat. Bear Lake is mapped as a 4.2-acre lake surrounded by old-growth conifer forest.

Within the Skagit Parcel Group, 22 acres of lake habitat are mapped at the Barnaby Slough parcel. The mapped lacustrine open water habitat is created by Harrison Dam constructed by WDFW on property owned by TNC. Vegetation around the slough is dominated by mid seral mixed coniferous and deciduous forest, with some shrub wetlands and riparian mixed forest interspersed within. Additionally, a one-acre lake is formed by the Powerline Pond off-channel fish habitat area on the Illabot North parcel owned by City Light.

No lacustrine habitats were mapped within any parcels in the Sauk Parcel Group.

4.6.2 Plant Species with Special Significance

City Light understands that some plant species may occur within the Project Boundary and on fish and wildlife mitigation lands that are culturally significant to the tribes. City Light anticipates consulting with tribes to obtain information regarding such species during the relicensing.

Commercially important plants in the Project Boundary and fish and wildlife mitigation lands include all species that are harvested for timber, primarily western red cedar and Douglas-fir. Non-commercial collecting of some berries (huckleberry, salmonberry, and non-native blackberry) as well as edible mushrooms and ferns have been observed (Tressler 2019). Additionally, trees are important in recreational areas to provide shade, and shrubs and grasses prevent erosion and increase the aesthetic values as these sites.

4.6.3 Invasive Species

For the purpose of this PAD, invasive plant species are defined as those species that are on one or more of the following lists:

- Washington State-designated noxious weeds (State NWCB 2006);
- County-designated noxious weeds (Skagit County 2018; Whatcom County 2019; Snohomish County 2019);
- NPS-designated first priority species (NPS 2015); and
- Other non-native or exotic plant species that are known to cause ecological damage to native plant communities.

In Washington, noxious weeds are defined as plants that, when established, are highly destructive, competitive, or difficult to control by cultural or chemical practices (Chapter 17.10 RCW). Weeds are classified based on the stage of invasion of each species. The classification is designed to: (1) eliminate new invasions before they spread; (2) prevent small infestations from becoming large infestations; (3) contain already established infestations to regions of the state where they occur and prevent their movement to non-infested areas; and (4) allow flexibility at the local level for landowner management programs (State NWCB 2006). Weeds are classified as follows (State NWCB 2006; RCW 17.10.010(2)):

- **Class A Weeds** — Non-native species with a limited distribution in the state. Eradication is required by state law.
- **Class B Weeds** — Non-native species established in some regions of Washington, but of limited distribution or not present in other regions of the state. Because of differences in

distribution, treatment of Class B weeds varies between regions of the state. In regions where a Class B weed is unrecorded or of limited distribution, prevention of seed production is required. In these areas, the weed is a "Class B designate," meaning it is designated for control by state law. In regions where a Class B species is already abundant or widespread, control is a local option. In these areas, the weed is a "Class B-selected," with containment, gradual reduction, and prevention of further spread being the chief goals. County noxious weed control boards may also designate Class B weeds for required control.

- **Class C Weeds** — Non-native species that are already widely established in Washington or of special interest to the state's agricultural industry. Counties may enforce control if locally desired, or choose simply to provide education or technical consultation to county residents.

The weed species known to occur in Whatcom, Skagit, and/or Snohomish counties, according to the State NWCB, are listed in Table 4.6-15. However, these listings are County-wide and not specific to the Project Boundary.

Table 4.6-15. County-designated weed species in Whatcom, Skagit, and Snohomish counties.

Scientific Name[1]	Common Name[1]	State/County Designation			
		State	Skagit	Whatcom	Snohomish
Abutilon theophrasti	velvetleaf	B	B-designated	B-designated	B-designated
Acroptilon repens	knapweed, Russian	B	B-designated	B-designated	B-designated
Aegilops cylindrica	jointed goatgrass	C	C	-	-
Ailanthus altissima	tree-of-heaven	C	C	C	-
Alhagi maurorum	camelthorn	B	B-designated	B-designated	B-designated
Alliaria petiolata	garlic mustard	A	A	A	A
Alopecurus myosuroides	blackgrass	C	C	-	-
Amorpha fruticosa	indigobush	B	B-designated	B-designated	B-designated
Anchusa arvensis	bugloss, annual	B	B-designated	B-designated	B-designated
Anchusa officinalis	bugloss, common	B	B-designated	B-designated	B-designated
Anthriscus sylvestris	wild chervil	B	B-designated	B-selected	B-designated
Artemisia absinthium	**absinth wormwood**	C	C	-	-
Arum italicum	Italian arum	C	C	C	-
Berberis vulgaris	common barberry	C	C	-	-
Berteroa incana	hoary alyssum	B	B-designated	B-designated	B-designated
Brachypodium sylvaticum	false brome	A	A	A	A
Bryonia alba	white bryony	B	B-designated	B-designated	B-designated
Buddleja davidii	**butterfly bush**	B	B-no control	B-selected	-
Butomus umbellatus	flowering rush	A	A	A	A
Cabomba caroliniana	fanwort	B	B-designated	B-designated	B-designated
Carduus acanthoides	thistle, plumeless	B	B-designated	B-designated	B-designated
Carduus nutans	thistle, musk	B	B-designated	B-designated	B-designated
Carduus pycnocephalus	thistle, Italian	A	A	A	A
Carduus tenuiflorus	thistle, slenderflower	A	A	A	A
Cenchrus longispinus	longspine sandbur	C	C	-	B-designated
Centaurea calcitrapa	purple starthistle	A	A	A	A

Scientific Name[1]	Common Name[1]	State/County Designation			
		State	Skagit	Whatcom	Snohomish
Centaurea diffusa	knapweed, diffuse	B	B-designated	B-designated	B-designated
Centaurea jacea	knapweed, brown	B	B-designated	B-designated	B-designated
Centaurea macrocephala	knapweed, bighead	A	A	A	A
Centaurea melitensis	Malta starthistle	B	B-designated	B-designated	-
Centaurea nigra	knapweed, black	B	B-designated	B-designated	B-designated
Centaurea nigrescens	knapweed, Vochin	A	A	A	A
Centaurea solstitialis	yellow starthistle	B	B-designated	B-designated	B-designated
Centaurea stoebe	**knapweed, spotted**	B	B-designated	B-selected	B-designated
Centaurea x moncktonii	knapweed, meadow	B	B-designated	B-selected	B-designated
Centromadia pungens	spikeweed	C	C	-	-
Chondrilla juncea	rush skeletonweed	B	B-designated	B-designated	B-designated
Cirsium arvense	**thistle, Canada**	C	C	C	-
Cirsium vulgare	**thistle, bull**	C	C	C	-
Clematis orientalis	**oriental clematis**	A	A	A	A
Clematis vitalba	**old man's beard**	C	C	C	-
Conium maculatum	poison hemlock	B	B-selected	B-selected	B-designated
Convolvulus arvensis	**field bindweed**	C	C	-	-
Cortaderia jubata	jubata grass	C	C	C	-
Cortaderia selloana	pampas grass	C	C	C	-
Crataegus monogyna	**English hawthorn**	C	C	C	C
Crupina vulgaris	common crupina	A	A	A	A
Cuscuta approximata	smoothseed alfalfa dodder	C	C	-	-
Cynoglossum officinale	houndstongue	B	B-designated	B-designated	B-designated
Cyperus esculentus	yellow nutsedge	B	B-selected	B-designated	B-designated
Cytisus scoparius	**Scot's broom**	B	B-selected	B-selected	-
Daphne laureola	spurge laurel	B	B-designated	B-designated	B-designated
Daucus carota	**wild carrot (except where commercially grown)**	C	C	-	-
Dipsacus fullonum	**common teasel**	C	C	-	-
Echium vulgare	blueweed	B	B-designated	B-designated	B-designated
Egeria densa	Brazilian elodea	B	B-designated	B-designated	-
Elaeagnus angustifolia	Russian olive	C	C	-	-
Epilobium hirsutum	**hairy willowherb**	B	B-designated	-	B-designated
Euphorbia esula	spurge, leafy	B	B-designated	B-designated	B-designated
Euphorbia myrsinites	spurge, myrtle	B	B-designated	-	B-designated
Euphorbia oblongata	**spurge, egg leaf**	A	A	A	A
Ficaria verna	lesser celandine	B	B-no control	B-selected	-
Foeniculum vulgare (except F. vulgare var. azoricum)	common fennel, (except bulbing fennel)	B	B-no control	B-designated	B-designated

Scientific Name[1]	Common Name[1]	State/County Designation			
		State	Skagit	Whatcom	Snohomish
Galega officinalis	goatsrue	A	A	A	A
Genista monspessulana	French broom	A	A	A	A
Geranium robertianum	**herb-Robert**	B	B-no control	B-selected	-
Geranium lucidum	shiny geranium	B	B-designated	B-designated	B-designated
Glyceria maxima	reed sweetgrass	A	A	A	A
Gypsophila paniculata	babysbreath	C	C	-	-
Hedera helix 'Baltica', 'Pittsburgh', and 'Star'; H. hibernica 'Hibernica'	**English ivy - four cultivars only**	C	C	C	-
Helianthus ciliaris	Texas blueweed	A	A	A	A
Heracleum mantegazzianum	giant hogweed	A	A	A	A
Hieracium aurantiacum	hawkweed, orange	B	B-designated	B-selected	B-designated
Hieracium, subgenus Hieracium	hawkweeds: All nonnative species and hybrids of the wall subgen	B	B-no control	B-selected	-
Hieracium, subgenus Pilosella	hawkweeds: All nonnative species and hybrids of the meadow subgenus	B	B-designated	B-designated	B-designated
Hydrilla verticillata	hydrilla	A	A	A	A
Hyoscyamus niger	black henbane	C	C	-	-
Hypericum perforatum	**common St. Johnswort**	C	C	C	-
Hypochaeris radicata	common catsear	C	C	-	-
Impatiens capensis	spotted jewelweed	C	C	C	-
Impatiens glandulifera	**policeman's helmet**	B	B-designated	B-selected	B-designated
Impatiens parviflora	small-flowered jewelweed	A	A	A	-
Iris pseudacorus	**yellowflag iris**	C	C	C	-
Isatis tinctoria	dyer's woad	A	A	A	A
Kochia scoparia	kochia	B	B-designated	B-designated	B-designated
Lamiastrum galeobdolon	**yellow archangel**	B	B-designated	B-designated	-
Lepidium appelianum	hairy whitetop	C	C	-	-
Lepidium draba	hoary cress	C	C	-	-
Lepidium latifolium	perennial pepperweed	B	B-designated	B-designated	B-designated
Leucanthemum vulgare	**oxeye daisy**	C	C		
Linaria dalmatica ssp. dalmatica	**Dalmatian toadflax**	B	B-designated	B-designated	B-designated
Linaria vulgaris	yellow toadflax	B	C	-	-
Ludwigia hexapetala	water primrose	B	B-designated	B-designated	B-designated
Ludwigia peploides	floating primrose-willow	A	A	A	A

Scientific Name[1]	Common Name[1]	State/County Designation			
		State	Skagit	Whatcom	Snohomish
Lysimachia vulgaris	loosestrife, garden	B	B-designated	B-designated	B-designated
Lythrum salicaria	loosestrife, purple	B	B-no control	B-designated	B-selected
Lythrum virgatum	loosestrife, wand	B	B-no control	B-designated	-
Matricaria perforata	scentless mayweed	C	C	-	-
Mirabilis nyctaginea	wild four-o'clock	A	-	A	A
Myriophyllum aquaticum	parrotfeather	B	B-designated	B-designated	B-designated
Myriophyllum heterophyllum	variable-leaf milfoil	A	A	A	A
Myriophyllum spicatum	Eurasian watermilfoil	B	B-no control	B-selected	B-selected
Nymphaea odorata	fragrant waterlily	C	C	C	-
Nymphoides peltata	yellow floatingheart	B	B-designated	B-designated	B-designated
Onopordum acanthium	thistle, Scotch	B	B-designated	B-designated	B-designated
Phalaris arundinacea	**reed canarygrass**	C	C	C	-
Phragmites australis	common reed (nonnative genotypes only)	B	B-designated	B-designated	B-designated
Picris hieracioides	hawkweed oxtongue	B	B-designated	B-designated	-
Polygonum cuspidatum	**knotweed, Japanese**	B	B-selected	B-designated	B-selected
Polygonum polystachyum	**knotweed, Himalayan**	B	B-designated	B-designated	B
Polygonum sachalinense	**knotweed, giant**	B	B-designated	B-designated	B-selected
Polygonum x bohemicum	**knotweed, bohemian**	B	B-no control	B-selected	B-selected
Potamogeton crispus	curlyleaf pondweed	C	C	C	-
Potentilla recta	**sulfur cinquefoil**	B	B-designated	B-designated	B
Pueraria montana var. lobata	kudzu	A	A	A	A
Rorippa austriaca	Austrian fieldcress	C	C	-	-
Rubus armeniacus	**Himalayan blackberry**	C	C	C	-
Rubus laciniatus	**evergreen blackberry**	C	C	C	-
Saccharum ravennae	Ravenna grass	B	B-no control	-	-
Sagittaria graminea	grass-leaved arrowhead	B	B-designated	B-designated	-
Salvia aethiopis	sage, Mediterranean	A	A	A	A
Salvia pratensis	meadow clary	A	A	A	A
Salvia sclarea	sage, clary	A	A	A	A
Schoenoplectus mucronatus	ricefield bulrush	A	A	A	A
Secale cereale	cereal rye	C	C	-	-
Senecio jacobaea	**tansy ragwort**	C	B-selected	B-selected	B-designated
Senecio vulgaris	common groundsel	C	C	-	-
Silene latifolia ssp. alba	white cockle	C	C	-	-

Scientific Name[1]	Common Name[1]	State/County Designation			
		State	Skagit	Whatcom	Snohomish
Silybum marianum	thistle, milk	A	A	A	A
Solanum elaeagnifolium	silverleaf nightshade	A	A	A	A
Solanum rostratum	buffalobur	C	C	-	A
Soliva sessilis	lawnweed	C	C	-	-
Sonchus arvensis ssp. arvensis	perennial sowthistle	C	C	-	-
Sorghum halepense	Johnsongrass	A	A	A	A
Spartina alterniflora	cordgrass, smooth	A	A	A	A
Spartina anglica	cordgrass, common	A	A	A	A
Spartina densiflora	cordgrass, dense-flowered	A	A	A	A
Spartina patens	cordgrass, saltmeadow	A	A	A	A
Spartium junceum	Spanish broom	A	A	A	A
Sphaerophysa salsula	Swainsonpea	C	C	-	-
Taeniatherum caput-medusae	medusahead	B	C	C	-
Tamarix ramosissima	saltcedar	B	B-designated	B-designated	B-designated
Tanacetum vulgare	**common tansy**	C	C	C	-
Thymelaea passerina	spurge flax	B	A	-	A
Tribulus terrestris	puncturevine	B	B-designated	B-designated	B-designated
Tussilago farfara	European coltsfoot	B	B-designated	B-designated	-
Typha spp	nonnative cattail species and hybrids	C	C	C	-
Ulex europaeus	gorse	B	B-designated	B-designated	B-designated
Ventenata dubia	ventenata	C	C	C	-
Xanthium spinosum	spiny cocklebur	C	C	-	-
Zostera japonica	Japanese eelgrass	C	C	-	-
Zygophyllum fabago	Syrian beancaper	A	A	A	A

Source: State NWCB 2006; Skagit County 2018; Whatcom County 2019; Snohomish County 2019.
1 Species name in bold are known or suspected to occur within/near the Project vicinity.

In addition to the 32 State NWCB-listed species known or suspected to occur in the Project Boundary or on other fish and wildlife lands, NPS has designated several ornamental species that have escaped from historical cultivation in Newhalem as “First Priority Species” (NPS 2015). A list of these species is summarized in Table 4.6-16.

Table 4.6-16. “First Priority Species” observed in the RLNRA.

Scientific Name	Common Name
Acer ginnala	Amur maple
Acer negundo	Box elder
Acer platanoides	Norway maple
Acer pseudoplatanus	Sycamore maple
Acer rubrum	Red maple
Acroptilon repens	Russian knapweed
Aesculus hippocastanum	Horse chestnut
Arctim lappa	Greater burdock
Cytisis scoparius	Scot’s broom
Ilex aquifolium	English holly
Juglans cinerea	Butternut
Juglans nigra	Black walnut
Linaria purpurea	Purple toadflax
Lunaria annua	Annual honesty
Prunus avium	Wild cherry
Prunus cerasifera	Thundercloud plum
Prunus domestica	Domestic cherry
Prunus laurocerasus	Cherry laurel
Robinia pseudoacacia	Bristly locust
Sorbus aucuparia	European mountain ash
Verbascum thapsus	Common mullein
Vinca minor	Small-leave periwinkle

Source: NPS 2015.

4.6.3.1 Invasive Species in the North Cascades National Park Complex

Surveys of exotic plants within the North Cascades National Park Complex were conducted by the NPS Invasive Plant Program (IPP) in 2001 and 2002 (Rochefort et al. 2016). The surveys focused on areas that were most susceptible to exotic plant invasion and primarily included roads, trails, riparian areas, and developed zones, but were not exclusive to the RLNRA or the Project Boundary. Approximately 96 miles of road, 306 miles of trails, 340 miles of riparian areas (including 102 miles along Ross Lake), and 189 acres of developed zones were surveyed within the North Cascades National Park Complex as part of the study and included a total of 225 sample plots. According to the report, 100 percent of the plots in developed areas and along roads contained exotic species. Plots with the greatest non-native plant cover were along roads between Newhalem and Diablo or at developed campgrounds. Additionally, exotic plant species were observed in 47 percent of the riparian sample plots and 18 percent of the trail plots.

On September 8-10, 2015, the IPP conducted additional ground-based surveys for invasive plants in the area burned by the Goodell fire and within the RLNRA. The fire was ignited by a lightning strike within the North Cascades National Park Complex on August 10, 2015 and due to dry climactic conditions, expanded to 3,200 acres in 9 days (NPS 2015). The Goodell fire burned through several developed areas within the Project Boundary along the Skagit River, including the town of Newhalem, a portion of the transmission line corridor, and SR 20. The survey was a result of the concern that invasive plants could rapidly expand and establish from these developed areas into the adjacent burned areas. Most of the species observed in the IPP surveys conducted shortly after the fire were herbaceous, likely due to the longer time needed by woody species to establish.

The IPP performed additional surveys of the SR 20 corridor and boat surveys along Ross Lake in 2016 and 2017, respectively. More recently, City Light performed invasive species surveys along the transmission line between Illabot Creek and the Skagit River and the Diablo and Newhalem townsites in the summer of 2018.

The invasive species documented in the Project Boundary during the 2016-2018 IPP and City Light studies are summarized below and presented in Table 4.6-17. The 2016 study documented 216 occurrences of invasive species along SR 20. Common species observed include oxeye daisy (*Leucanthemum vulgare*), spotted knapweed (*Centaurea stoebe*), and herb-Robert (*Geranium robertianum*). The 2017 boat surveys resulted in the mapping of 53 acres along the shores of Ross Lake (see below). The 2018 City Light study documented 65 occurrences of invasive species at the Newhalem townsite and 29 occurrences in the Diablo area. Invasive species occurred through much of the townsites, and Himalayan blackberry, St. Johnswort, common tansy, and English holly (*Hedera helix*) were found at both sites. Several of NPS "First Priority Species" were also observed at the Newhalem townsite and include sycamore maple (*Acer pseudoplatanus*), common mullein (*Verbascum Thapsus)*, black walnut (*Juglans nigra*), and purple toadflax (*Linaria purpurea*).

Table 4.6-17. Invasive[1] species documented in the portion of the Project Boundary within the RLNRA (2016-2018).

Scientific Name[2]	Common Name[2]	Location Observed				
		Diablo	Newhalem	SR 20	Transmission Line	Ross Lake
Acer negundo	**boxelder**		X			
Acer pseudoplatanus	**sycamore maple**	X	X			
Aesculus hippocastanum	**horse chestnut**		X			
Aegopodium podagraria	Bishop's goutweed	X	X			
Artemisia absinthium	**absinthium**	X	X			
Arctium lappa	**greater burdock**	X				
Bromus arvensis	field brome		X			
Brassica sp.	mustard		X			
Bromus inermis	smooth brome	X				
Campanula rapunculoides	rampion bellflower		X			
Centaurea stoebe	**spotted knapweed**		X	X		
Chenopodium album	lambsquarters					
Cirsium arvense	**Canada thistle**	X		X		
Cirsium vulgare	**bull thistle**		X			
Clematis vitalba	**old man's beard**		X	X		
Convolvulus arvensis	**field bindweed**	X				
Conium maculatum	**poison hemlock**					

Scientific Name[2]	Common Name[2]	Location Observed				
		Diablo	Newhalem	SR 20	Transmission Line	Ross Lake
Crataegus monogyna	**oneseed hawthorn**	X	X			
Cytisus scoparius	**Scot's broom**		X		X	
Dactylis glomerata	orchardgrass					
Digitalis purpurea	purple foxglove	X	X	X		
Erysimum cheiranthoides	wormseed wallflower		X			
Euphorbia oblongata [3]	**spurge, Balkan**	X				
Euphorbia peplus[3]	spurge, petty		X			
Fagus sylvatica	European beech		X			
Geranium lucidum	**shining geranium**					
Geranium robertianum	**Robert geranium**		X	X		
Hedera helix	**English ivy**		X			
Hesperis matronalis	dames rocket	X	X			
Hieracium caespitosum	**meadow hawkweed**			X		
Hieracium floribundum	**hawkweed**			X		
Hypericum perforatum	**common St. Johnswort**	X	X		X	
Ilex aquifolium	**English holly**					
Impatiens glandulifera	**ornamental jewelweed**				X	
Juglans nigra	**black walnut**		X			
Lapsana communis	common nipplewort	X	X			
Lathyrus latifolius	perennial pea			X		
Leucanthemum vulgare	**oxeye daisy**	X	X	X		
Linaria dalmatica toadflax	**Dalmatian toadflax**	X	X	X		
Melilotus officinalis	sweetclover	X				
Mycelis muralis	wall-lettuce	X				
Phalaris arundinacea	**reed canarygrass**				X	X[4]
Plantago lanceolata	narrowleaf plantain	X				
Polygonum cuspidatum	**Japanese knotweed**			X		
Polygonum sp	**knotweed**	X				
Potentilla recta	**sulphur cinquefoil**			X		
Prunus spinosa	blackthorn	X				
Robinia hispida	bristly locust		X			
Robinia pseudoacacia	**black locust**	X	X			
Rumex acetosella	common sheep sorrel	X				
Rubus armeniacus	**Himalayan blackberry**	X	X	X	X	
Rubus laciniatus	**cutleaf blackberry**		X		X	
Rumex crispus	curly dock	X	X			

Scientific Name[2]	Common Name[2]	Location Observed				
		Diablo	Newhalem	SR 20	Transmission Line	Ross Lake
Silene vulgaris	maidenstears		X			
Sonchus arvensis	**field sowthistle**	X	X			
Sonchus asper	spiny sowthistle		X			
Sorbus aucuparia	**European mountain ash**		X			
Tanacetum vulgare	**common tansy**	X	X		X	
Verbascum thapsus	**common mullein**	X	X	X		
Vinca minor	**common periwinkle**	X	X			

Source: NPS National Invasive Species Information Management System (NISIMS) database unless otherwise noted.
1 This table includes species listed as "exotic" by the NPS which is defined as "those that occupy park lands as a result of deliberate or accidental human actions" (Rochefort et al. 2016).
2 Species names in bold are on the State NWCB list or listed as a "Priority Species" by NPS.
3 Source: Denovan 2019.
4 Source: McAvinchey et al. 2017; McAvinchey and Wilhoit 2019.

Reed Canarygrass

In 2003, NPS performed an invasive weed survey along Ross Lake that mapped approximately 50 acres of reed canarygrass (*Phalaris arundinacea*) along the shoreline (NPS 2011). In 2011, plants were mapped along the east and west shores of the reservoir, primarily in the north and south extents, as well as some patches within Ruby Arm and the associated wetlands. 279 distinct patches were mapped, with 56 percent of them being less than 0.1 acre. The larger patches were along the west shore, with the most extensive being 34.6 acres along an approximately 1.4-mile stretch near the outlet of Silver Creek (Bivins 2019). Additionally, NPS has reported that reed canarygrass has spread from the Ross Lake shoreline into natural wetland complexes within the Big Beaver drainage (NPS 2011; McAvinchey and Wilhoit 2019).

The largest concentration of reed canarygrass (360 acres) in Ross Lake is at the head of the reservoir in Canada. Very small patches of reed canarygrass occur at many other sites along the Ross Lake shoreline between Ruby Arm and Hozomeen (McAvinchy et al. 2017).

Knotweed

Specific to the RLNRA, NPS has reported small populations of Japanese knotweed (*Fallopia japonica*), totaling less than 10 acres, along the Skagit River from the base of the Gorge Dam to the park boundary near the Copper Creek boat launch. City Light, NPS, and TNC continued cooperation to treat these populations with an herbicide to control the population (NPS 2011). NPS also mapped a small patch of knotweed along SR 20 approximately five miles from the RLNRA boundary. Skagit Fisheries Enhancement Group (SFEG), NPS, and City Light continue to monitor and control knotweed infestations.

4.6.3.2 Invasive Species in the Transmission Line Corridor Outside of the RLNRA

As mentioned above, past management outside of the North Cascades National Park Complex, such as transmission line corridor road maintenance and vegetation management, has resulted in the establishment of some invasive vegetation that thrives in disturbed conditions. Based on aerial photos, species that can tolerate disturbed conditions, primarily Himalayan blackberry, old man's beard, common tansy, and Scot's Broom, occur in scattered patches throughout large areas of the corridor. However, the distribution of invasive species along the corridor often depends on the underlying land ownership, as City Light has limited authority to control weed species on private parcels.

Himalayan blackberry is a non-native invasive species targeted for control for riparian habitat restoration downriver of the dams. Casey (2006), in characterizing riparian plant communities along the Skagit and Sauk rivers, found Himalayan blackberry in the Marblemount-Sauk River and Sauk River-Sedro Woolley reaches of the Skagit River, where it was found on all but one transect. It was not detected in the sampled plots between Newhalem and Marblemount but it is known to occur there now. Non-native Scot's broom was not found upriver of Marblemount but was present in the Marblemount-Sauk reach (5.7 percent cover) and Sauk (4.1 percent cover) reaches, and was rare in the lower Skagit reach (0.4 percent cover).

4.6.3.3 Invasive Species on Fish and Wildlife Mitigation Lands

Invasive species common to the region have been observed on the fish and wildlife mitigation lands. These primarily include Himalayan blackberry, reed canarygrass, Japanese knotweed, tansy ragwort, common tansy, Policeman's helmet, Canada thistle, and Scot's broom. No quantitative surveys have been conducted for invasive species on these lands.

4.6.4 Vegetation Management

4.6.4.1 Transmission Line Vegetation Management

Vegetation management practices are limited in areas of the transmission line corridor not owned by City Light, which is the majority of the ROW. Vegetation management of the transmission line ROW is divided between two crews. The Newhalem crew manages the ROW from just south of the Sauk River crossing, north to Ross Lake. The Bothell crew manages the ROW from the Bothell Substation to just south of the Sauk River crossing. Vegetation management in both portions of the ROW is performed year-round. Vegetation management practices are compliant with City Light's Transmission ROW Vegetation Management Plan, which focuses on the safety of the public and the Project, while preserving the aesthetics of the natural environment to the extent possible. Throughout the transmission line corridor, the size and location of vegetation must meet NERC sag and sway clearance requirements and typically, vegetation is kept 25 feet, vertically and horizontally, away from the lines. Additionally, City Light has created a Riparian Zone Management Plan to identify stream crossings and apply prescriptive buffers to ensure continued adequate riparian vegetation during ROW vegetation management activities (Heffley 1990). Generally, buffers are 75 feet on each bank of the stream, although some smaller, intermittent streams may only require a 25-foot buffer if found adequate to protect ecological function. Medium to low deciduous trees are allowed in these buffers, but are removed as they grow and present a hazard to the transmission lines (Heffley 1990).

Within the RLNRA, the Washington Park Wilderness Act allows for the removal of vegetation within the corridor to protect the transmission lines, towers, and equipment. Vegetation removal is done only to the extent practicable for maintenance and conducted in a way that protects the scenic viewsheds for the public (City Light 1990). In these managed areas, vegetation within the corridor is frequently dominated by small native trees and shrubs that provide a natural aesthetic without interfering with operation or safety of the transmission line. Trees are removed or girdled as they grow taller and begin to pose a threat to Project operations. The Newhalem crew primarily girdles trees that need to be removed. In highly visible areas, all trees are removed and chipped while in less visible areas, trees will be left to die and fall. In addition to vegetation within 25 feet of the corridor, crews will remove dead and dying trees, or "danger trees," that pose a threat to the lines or towers. In areas where vegetation does not pose a threat to the transmission lines, it will be allowed to grow to its maximum height. All vegetation is removed using hand tools and power tools with the only areas that are periodically mowed being along the roads, which is typically done once a year or less. According to the Transmission ROW Vegetation Management Plan, management procedures should allow natural regrowth as well as planned control that will encourage wildlife browsing where appropriate (City Light 1990). For that reason, herbicides are used on a limited basis. Herbicides are primarily used on Scot's broom. Generally, crews cut and treat Scot's broom in the spring when flowers begin to bloom. Treated areas will be revisited two weeks later and crews will reapply herbicides to areas that were missed. In riparian areas, trees will be topped or removed if they pose a threat to the lines but shrubs will be left so they can grow tall enough to provide shade to the stream. No herbicide treatments are applied in riparian areas. The Newhalem crew also manages vegetation, including invasive species, in the Newhalem and Diablo townsites.

South of the Sauk River, the Bothell crew primarily focuses on vegetation clearing and herbicide applications, along with some road maintenance. The transmission line corridor is divided into several segments, which are treated quarterly. Crews start at one end of the segment and move to the other end performing whatever treatments are needed including mowing, applying herbicides, removing trees (Bayard 2019). Crews follow the Transmission ROW Vegetation Management Plan to the extent possible; however, in general, the Bothell crew removes more trees and mows more areas than the Newhalem crew. According to Washington state law, City Light is not able to prescribe what the landowner may grow under the transmission line but City Light is able to manage vegetation growing within clearances. In addition, City Light has no control over other landowner vegetation management decisions and landowners may remove more vegetation than the Transmission ROW Vegetation Management Plan recommends, apply herbicides, and/or disregard invasive species (City Light 1990).

4.6.4.2 Vegetation Management near Newhalem and Diablo

In Newhalem and Diablo, City Light activities that impact vegetation include routine maintenance of roads and parking areas (grading, filling potholes, repaving), landscaping (mowing, weeding, tree pruning, hazard tree removal, and replanting) in lawns and ornamental planting areas, and occasional maintenance of utilities (water and sewer lines). In 2014, City Light initiated invasive species management and habitat restoration to address areas between Diablo and Goodell Creek, including the accessible portions of the transmission line corridor and the Skagit River riparian zone. Management has included mechanical and herbicide treatments and replanting.

4.6.4.3 Vegetation Management within the RLNRA

NPS currently uses the herbicide Glyphosate to treat infestations of reed canarygrass. Herbicides used in riparian and wetland areas are limited to spot applications, using only herbicides approved for aquatic environments. Pilot projects have been successful in controlling populations along the reservoir. However, NPS has not reached an agreement with the Canadian government for the use of herbicides on the large concentration north of the border; therefore, this infestation continues to disperse reed canarygrass to other sections of the reservoir shoreline as well as downriver locations (NPS 2011).

The Upper Skagit Knotweed Control Program, first initiated by TNC in 2001, has been controlling knotweed in the upper Skagit River watershed with several partners including USFS, City Light, NPS, and the Sauk-Suiattle Indian Tribe. Eradication efforts take place both within and outside of the RLNRA. In 2017, SFEG, along with various partners, treated knotweed using a prioritized, top-down, watershed-scale approach along rivers in the upper Skagit River watershed and monitored previously treated knotweed patches. During the 2017 study, 3,087 knotweed stems in 137 patches were treated, throughout the watershed, with a foliar application of one percent imazapyr mixed with one percent Agridex as the adjuvant (SFEG 2017).

4.6.4.4 Vegetation Management on Fish and Wildlife Mitigation Lands

City Light manages its fish and wildlife mitigation lands, including those already in the Project Boundary and the recently acquired land that have not yet been added to the Project Boundary in accordance with City of Seattle policies. It is City policy to use landscape management techniques that protect and enhance natural ecosystems, including practicing the principles of Integrated Pest Management, which include controlling noxious weeds to comply with applicable state and county weed laws. The City also has a pesticide reduction strategy in place to reduce overall pesticide use and eliminate the use of the most hazardous pesticides (City Light 2006). In 2018, the City directed all of its departments, including City Light, to stop using herbicides containing glyphosate.

City Light has signed a MOA allowing SFEG and the Sauk-Suiattle Indian Tribe to control knotweed on City Light property including the fish and wildlife mitigation lands in the Skagit and Sauk watersheds (Tressler 2019). Management strategies for these lands are developed and implemented cooperatively with the WMRC, which includes members of USFWS, NPS, USFS, WDFW, and three Skagit Tribes (Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community). While the Skagit Wildlife Mitigation Lands Management Plan (City Light 2006) does not specify weed management at these sites, City Light routinely conducts weed management on several fish and wildlife mitigation lands in consultation with the WMRC, as discussed above for Illabot Creek North. City Light conducts very limited vegetation management activities on the fish and wildlife mitigation lands. Vegetation management within the fish and wildlife mitigation lands is done on an as-needed basis and primarily involves restoration work to improve habitat and the removal of invasive species. The primary activities completed through coordination and partnership with the WMRC member organizations during the current Project license that affect vegetation resources include the following:

- Abandonment of more than 22 miles of former logging roads that existed on the properties when acquired by City Light.
- Planting of sections of the former rock quarry on Bacon Creek property.
- Annual haying of McLeod Slough field.
- Maintenance of fish channels that require routine removal of beaver dams at County Line and

Newhalem Ponds properties and use of a pond leveler on the Powerline Pond (Illabot North wildlife area).

- Extensive reforestation planting and weed control of pasture and riparian areas on the Savage Slough and Johnson properties.
- Weed control along 1.5 miles of transmission line and patrol road on the Illabot North wildlife mitigation property, from Illabot Creek to the Skagit River for Scot's broom. Treated for policeman's helmet, clematis, butterfly bush (*Buddleja davidii*), and St. Johnswort (*Hypericum perforatum*) in 2018-2019 (Tressler 2019).
- Removal of road prism from O'Brien Slough (Figure 4.6-4).
- Creation of 14-acre elk forage fields on South Fork Nooksack property through tree removal, seeding and annual mowing and weed control (Figure 4.6-5).
- Access control measures at Dan Creek to prevent timber theft.
- Knotweed control along Sauk and Skagit Rivers.
- Removal of caretaker house at Barnaby Slough.
- Illabot Creek Restoration – connection to former channel and revegetation of restoration spoil material placed on transmission line on Illabot South property.

Figure 4.6-4. Road prism removed by SRSC at O'Brien Slough, 2008.

Figure 4.6-5. South Fork Nooksack elk forage area which is maintained by the Upper Skagit Indian Tribe, 2018.

4.6.5 Fire Management

The North Cascades National Park Complex Wildland Fire Management Plan (NPS 2010) includes four management strategies: suppression, use of fire, prescribed fire, and manual/mechanical thinning (NPS 2010). Fire suppression is required on 47,851 acres (7 percent of North Cascades National Park Complex) and wildland fire use is an option on 633,250 acres (93 percent of North Cascades National Park Complex). The Plan includes the following project and program elements near the Project Boundary:

- **Use of Fire.** An assumed average of 200 acres (North Cascades National Park Complex-wide) will burn each year as a result of lightning ignitions that would be allowed to burn for the benefit of the resources.
- **Suppression.** An assumed average of 260 acres (North Cascades National Park Complex-wide) will burn each year as suppression fires (i.e., unwanted fires that are actively extinguished by fire management staff).
- **Hozomeen Contours.** Between 1,630 and 3,030 acres above Ross Lake near Hozomeen will be prescribed burned per year.
- **Re-ignition of Suppressed Fires.** Up to 200 acres (North Cascades National Park Complex-wide) will be burned through the re-ignition of suppressed fires per year.

Most of the portion of the Project Boundary near Ross Lake is in the Wildland Fire Use Zone, with the exception of the northern extent near the U.S.-Canada border, which is in the Suppression Zone. The lower elevation reaches of the Project Boundary, within the North Cascades National Park Complex, are in the Suppression Zone that includes the SR 20 highway corridor, southern extent of Ross Lake, Diablo Lake, Gorge Lake, transmission line ROW, and the Skagit River corridor.

Based on tree ring analysis and historical records, the natural fire rotation in the RLNRA is estimated to be 100 years. Large fires in the Upper Skagit Valley have been documented in 1859 and 1926 (NPS 2010); the most recent fire near the Project was the Goodell Creek fire, which occurred in August 2015. This fire, which was started by a lightning strike on the flank of Ross Mountain, spread east, north, and south, burning over 7,000 acres (NPS 2015). It burned in the Project Boundary near Newhalem and Gorge Powerhouse, including portions of the transmission line corridor and Trail of the Cedars and Ladder Creek (Figures 4.6-6 and 4.6-7).

Three years prior to the Goodell Creek fire, City Light decided to pursue the FireWise USA® Program, a national program designed to encourage individuals and communities to prepare for wildfire, in the Project townsites. This preparation included clearing vegetation around homes and other buildings (i.e., creating defensible space), planting fire-resistant plants, following outdoor burning rules, and having a plan for fires. Newhalem was recognized in 2013 as a FireWise community and Diablo shortly thereafter. Since the Goodell Creek fire, City Light has developed and implemented an evacuation plan and coordinated with local and regional partners to prepare for future fires. To continue being a FireWise USA member, City Light is required to engage with the community, have a fire mitigation plan, and implement FireWise activities.

Figure 4.6-6. Smoke at Gorge Powerhouse.

Figure 4.6-7. Fire burning along Trail of the Cedars.

4.6.6 Rare, Threatened, and Endangered Plant Species

RTE plant species include all taxa with federal or state protective status. For the purposes of this PAD, RTE plant species are those species that are on one or more of the following lists:

- **ESA Federally Listed or Proposed** – Species that are listed and protected under the ESA of 1973, as Endangered, Threatened, or Proposed for listing.
- **ESA Federal Candidates** – A species for which USFWS has sufficient information on the biological vulnerability and threats to support a proposal to list it as Endangered or Threatened under the ESA, but the development of listing regulations has not occurred because of other higher priority listing activities.
- **ESA Federal Species of Concern** – A species, usually thought to be in decline, which may be considered for federal candidate status in the future.
- **State Listed Species** – Species listed by the Washington DNR NHP on an advisory basis as Endangered, Threatened, or Sensitive.
- **USFS Sensitive Species** – Species on the Regional Forester's List of Sensitive Species for the Mount Baker – Snoqualmie National Forest (USFS 2019).

4.6.6.1 Species Occurrence and Habitat Requirements in the North Cascades National Park Complex

Federally Listed Species

No ESA-listed or proposed plant species have been observed or mapped within the Project Boundary, including the fish and wildlife mitigation lands. Additionally, USFWS, through the IPaC website, provides a site-specific species list for the Project Boundary which is appended to this PAD. The only botanical resource identified in the IPaC report is whitebark pine (*Pinus albicaulis*). This species is a candidate for listing under the ESA and has been documented within the North Cascades National Park Complex. However, this species grows on cold, dry sites above 5,000 feet and, therefore, is not present within the Project Boundary (Hoffman et al. 2015).

State Listed Species

A vascular plant inventory of the North Cascades National Park Complex conducted by NPS staff between 2000 and 2008 addressed a list of sensitive plant species that may be present in the park and included 73 state-listed, sensitive species that occur in Whatcom, Skagit, or Chelan counties. Of these, 17 species have historical records of being observed within the North Cascades National Park Complex boundary. Because most of these 17 species had not been observed in over a decade, the NPS inventory prioritized locating the documented species before looking for more species (Bivin and Rochefort 2010). The project succeeded in locating 9 of the 17 RTE plant species within the North Cascades National Park Complex. There are currently 31 species with the conservation status of "vulnerable" or higher among species documented or suspected to occur in the North Cascades National Park Complex. A summary of the sensitive species that have been recorded in the North Cascades National Park Complex, over several survey efforts as recently as 2010, is presented in Table 4.6-18.

In addition to the studies noted above, the WNHP provides limited GIS data on the location of observed rare plants throughout the state. These species are often associated with the WHCV described above. Three vascular RTE plant species were mapped by the WNHP as occurring within the Project Boundary. All were observed to occur within Big Beaver Creek and include stalked moonwort (observed in 2002), treelike clubmoss (observed in 1986) and boglike clubmoss (also observed in 1986). Habitat requirements for these species can be found in Table 4.6-18.

Table 4.6-18. Sensitive vascular species potentially occurring in the North Cascades National Park Complex.

Species Name[1]	Common Name[1]	Last Documented	State Status (Rank) 2012[2]	Change since 1997[3]	Habitat Requirements[4]
Botrychium hesperium	**Western moonwort**		S(S2)		Moist open areas in meadows and forests.[5]
Botrychium paradoxum	**Twin-spiked moonwort**	Suspected	T(S2)	↑S-T	Late-seral western redcedar forests on floodplains, perennial or intermittent stream terraces, wet or dry meadows, compacted old rockbeds, rocky subalpine slopes, and early-seral lodgepole pine communities.
Botrychium pedunculosum	Stalked moonwort	2010	S(S2)		Moist or dry meadows, springs, stream terraces, coniferous forests, and forest edges.
Carex capillaris	Hair-like sedge	2010	T(S1)	↑S-T	Streambanks, wet meadows, bogs, and marshy lake lakeshores.
Carex heteroneura	**Different nerved sedge**		S(S2S3)		Wet meadows to dry slopes.[5]
Carex macrochaeta	**Large awned sedge**	2010	T(S1)	↑S-T	Moist open spaces, including seeps and wet meadows, and around streams, lakes, and waterfalls
Carex magellanica ssp. *irrigua*	Poor sedge	1986	S(S2S3)		Fens, bogs, shady wet meadows, shrub wetlands, and marshes; often in peat soil.
Carex media	**Norway sedge**		S(S2)		Moist meadows and perennial streams and ponds.[5]
Carex pluriflora	**Several flowered sedge**	1988	S(S1/S2)		Wetlands, boggy lake margins, prairies, streambanks, and coastal inland areas.
Carex rostrata	Beaked sedge	2010	S(S1)		Fens, bogs, quaking or floating peat, lake and stream shores, wet meadows; often in shallow water or on floating mats.
Cicuta bulbifera	**Bulb-bearing hemlock**		S(S2S3)		Edges of marshes, lakes, bogs, meadows, shallow standing or slow moving water.[5]
Dendrolycopidium dendroidium	**Treelike clubmoss**		S(S1)		Rock outcrops, talus fields, moss, and significant debris layers.[5]
Draba aurea	Golden draba	Suspected	S(S1S2)		Forested slopes, alpine meadows, and dry, relatively open, sunny areas at high elevations.
Eriophorum viridicarinatum	**Thinleaf cotton sedge**	2010	S(S2)		Obligate wetland species of cold, usually calcareous swamps, bogs, fens, ponds, and wet meadows.
Erigeron salishii	Salish fleabane	2010	S(S2)		Alpine zone on dry, rocky, or scree slopes and ridge tops with granite, rock, talus, sand, or loess soils; 2,000 to 2,800 meters.

Species Name[1]	Common Name[1]	Last Documented	State Status (Rank) 2012[2]	Change since 1997[3]	Habitat Requirements[4]
Gentiana glauca	Glaucous gentian	Suspected	S(S2)		On hummocks and in seepage areas in moist alpine and subalpine meadows.
Githopsis speculariodes	Common blue-cup	1970	S(S3)		Dry, open places at lower elevations, such as thin soils over bedrock outcrops, grassy balds, talus slopes, and gravelly prairies.
Hypericum majus	**Canadian St. Johnwort**		S(S2)		Along ponds and lakeshores, riparian areas.[5]
Iliamna longisepala	Longsepal globemallow	Suspected	S(S3)		Gravelly stream sides in open shrub-steppe and forests on the east side of the Cascades; also on open hillsides in microsites not immediately adjacent to stream channels.
Loiseleuria procumbens	Alpine azalea	1963	T(S1)	↑S-T	Alpine slopes and cold, dry areas at high elevations (1,800–2,000 meters).
Luzula arcuata	Curved woodrush	2010	S(S1)		Alpine to subalpine glacial moraines, mountain meadows, rocky and gravelly areas, rocky ridges, talus, bare patches of sandy soil; often adjacent to snow fields.
Lycopodiella inundata	**Bog clubmoss**	2010	S(S2)		Sphagnum bogs, wet sandy places, and wetlands adjacent to lakes, marshes, and swampy grounds.
Lycopodium dendroideum	**Treelike clubmoss**	2010	S(S2)		Rock outcrops, talus, or boulder fields; often with a significant moss layer. In ecotone between meadow/ wetland and adjacent forest.
Montia diffusa	Branching montia	Suspected	S(S2S3)		Moist forests and open fir woodlands in the lowland and lower montane zones; occasionally in xeric soils or disturbed sites.
Oxytropis campestris var. *gracilis*	Slender crazyweed	Suspected	S(S2)		Montane sites on glacial outwash terraces in sandy loam soil, scree, and alpine tundra.
Parnassia kotzebuei	Kotzebue's grass of Parnassus	2010	T(S1)	↑S-T	Damp mossy ledges at the base of granitic cliffs, and adjacent to lakes, in moist seepage at the base of talus slopes.
Platanthera obtusata	Small northern bog orchid	1991	S(S2)		Damp or wet places in forests, marshes, bogs, meadows, and streambanks.
Poa arctica ssp. arctica	Gray's bluegrass	1982	W?(SNR)		Meadows, mostly above timber line.[6]
Polemonium viscosum	Skunk polemonium		S(S1S2)		At high altitudes, commonly above timberline, in open rocky places, talus slopes, rock outcrops, glacial cirques, and alpine fellfields.

Species Name[1]	Common Name[1]	Last Documented	State Status (Rank) 2012[2]	Change since 1997[3]	Habitat Requirements[4]
Saxifraga hyperborea	Pygmy saxifrage	2010	?(S3)		Damp, shaded cliffs, rock crevices, and talus in alpine and subalpine areas; commonly as single plants.
Silene seelyi	Seely's silene	2000	S(S2S3)	↓T-S	Shaded crevices in ultramafic, granitic, or basaltic cliffs and rock outcrops, and occasionally among boulders in talus; restricted to sites with poor nutrient and water availability.
Spiranthes porrifolia	**Western ladies tresses**		S2		Meadows, seeps, streams.[5]

Source: Bivin and Rochefort (2010) unless otherwise noted.

1 Species names in bold are known or likely to occur within the Project vicinity. Source: Bivin 2019.

2 S=Sensitive; T=Threatened; W=Watch List. More detail on state status codes at: https://www.dnr.wa.gov/publications/amp_nh_vascular_ets.pdf?u1oah.

3 ↓= decrease in protection; ↑=increase in protection.

4 Source: Camp and Gamon (2011) unless otherwise noted.

5 Source: Bivin 2019.

6 Source: Hitchcock 1971.

4.6.6.2 Species Occurrence and Habitat Requirements in Transmission Line Corridor

As part of studies for the current Project license, City Light performed an RTE plant survey in support of the Transmission ROW Vegetation Management Plan (City Light 1990). The study area was defined as the 20-mile City Light transmission line ROW corridor within the RLNRA, between Ross Dam and near the confluence of the Bacon Creek with the Skagit River. No RTE plant species were found (City Light 1990).

GIS data provided by WNHP included no occurrences of RTE plant species in the transmission line corridor outside of the North Cascades National Park Complex. The only mapped occurrence of an RTE plant species in the vicinity of the corridor is a 1986 observation of few-flowered sedge (*Carex pauciflora*). This species, classified as State Sensitive, was recorded in a wetland area outside of Lake Martha, approximately 3.1 miles north of Lake Stevens in Snohomish County. Habitat requirements of few-flowered sedge are wet, acidic environments at low to middle elevations (75-1,390 meters), including sphagnum bogs and acidic peat, usually on open mats, but also in partial shade (Camp and Gamon 2011).

USFS Sensitive Species

Portions of approximately five miles of the transmission line corridor between Bacon Creek and Marblemount are within the Mt. Baker-Snoqualmie National Forest Boundary (although most of the parcels are privately owned). USFS Region 6 Forester's Sensitive Species List (USFS 2019) includes 46 plant species that are listed for special management considerations because of their relative rarity (Table 4.6-19). It is not known if any of these species have been documented in the Project vicinity.

Table 4.6-19. USFS Region 6 Forester's Sensitive Species List.

Scientific Name	Common Name	Documented (D) or Suspected (S) on the MBSNF	Habitat Requirements[1]
Botrychium ascendens	Upward-lobed moonwort	D	Coniferous forests, wet and dry meadows, streambanks, pastures, roadsides, ravines; often with other *Botrychium* spp.
Botrychium hesperium	Western moonwort	D	Sagebrush shrubland, moist and dry meadows, forest edges; in dry, gravelly, sandy loams.
Botrychium pedunculosum	Stalked moonwort	D	Moist or dry meadows, springs, streams, coniferous forests and forest edges.
Campanula lasiocarpa	Alaska harebell	D	Alpine heaths and sandy tundras; rock crevices and rocky microsites in wet subalpine areas.
Carex comosa	Bristly sedge	S	Marshes, lakeshores, and wet meadows.
Carex macrochaeta	Large-awn sedge	S	Moist open spaces, including seeps, wet meadows, and around streams, lakes, and waterfalls.
Carex pauciflora	Few-flowered sedge	D	Wet, acidic environments at low to middle elevations (75-1,390 meters), including sphagnum bogs and acidic peat; usually on open mats but also in partial shade.

Scientific Name	Common Name	Documented (D) or Suspected (S) on the MBSNF	Habitat Requirements[1]
Carex proposita	Smoky Mountain sedge	D	Open, dry, rocky slopes, and dry meadows near lakes and streams.
Carex rostrata	Beaked sedge	S	Fens, bogs, quaking or floating peat, lakes and streams, wet meadows.
Carex scirpoidea ssp. *scirpoidea*	Canadian single-spike sedge	D	Moist alpine meadows, streambanks, and open rock slopes, often above timberline.
Carex stylosa	Long-styled sedge	D	Ponds, bogs, fens, shallow marshes, streambanks, and moist meadows.
Castilleja cryptantha	Obscure Indian-paintbrush	S	Grassy subalpine meadows, parklands in the upper alpine zone, often near stream channels and seeps.
Chaenactis thompsonii	Thompson's chaenactis	D	Dry rocky slopes and ridges at elevations of 880-2,130 meters with sparse or xerophytic vegetation.
Cicuta bulbifera	Bulb-bearing water-hemlock	S	Obligate wetland species found at edges of marshes, slow-moving stream, lake margins, bogs, wet meadows, and shallow standing water.
Coptis aspleniifolia	Spleenwort-leaved goldthread	D	Moist, cool, old forests with a well-developed litter layer (30-930 meter elevation).
Dryas drummondii var. drummondii	Drummond's mountain-avens	D	Harsh, inaccessible calcareous habitats, including crevices of steep dry cliffs.
Erigeron salishii	Salish fleabane	D	Crevices and cracks in basalt cliffs on canyon walls at 380 to 460 meters.
Eurybia merita	Arctic aster	D	Open rock places, rock crevices, unstable talus slopes from 700 to 2,300 meters.
Fritillaria camschatcensis	Black lily	D	Moist open meadows, around 1,000 meters.
Gaultheria hispidula	Creeping snowberry	S	Sphagnum bogs, wet forests, and riparian meadows; areas of moist bogs and standing water in fir/spruce forests.
Gentiana douglasiana	Swamp gentian	D	Wet to moist meadows, seeps, prairie drainages, pond edges, and small bogs undergoing succession to coniferous forest.
Gentiana glauca	Glaucous gentian	D	On hummocks and in seepage areas in moist alpine/subalpine meadows (1,890-2,350 meters).
Heterotheca oregona	Oregon goldenaster	S	Sand and gravel bars along rivers and streams; at the edge of a mixed Douglas-fir/Ponderosa pine forest (800 meters).
Impatiens noli-tangere	boreal jewelweed	D	Moist woods.
Kalmia procumbens	Alpine azalea	D	Alpine slopes and cold, dry areas at high elevations (1,800-2,000 meters).
Luzula arcuata ssp. *unalaschcensis*	Alaska curved woodrush	D	Alpine to subalpine glacial moraines, mountain meadows, rocky and gravely areas, talus; often adjacent to snow fields.

Scientific Name	Common Name	Documented (D) or Suspected (S) on the MBSNF	Habitat Requirements[1]
Lycopodiella inundata	Bog club-moss	D	Sphagnum bogs, wet sandy places, and wetlands adjacent to lakes, marshes, and swampy grounds.
Lycopodium dendroideum	Treelike clubmoss	D	Rock outcrops, talus, or boulder fields; often with a significant moss layer; in ecotone between meadow/wetland and adjacent forest.
Malaxis monophyllos var. *brachypoda*	White adder's-mouth orchid	D	Wetland sites, including bogs, mires, swamps, swales, and wet meadows.[2]
Microseris borealis	Northern microseris	S	Wet meadows, bogs (10-1,450 meters). Obligate wetland species in perennial and seasonal wetlands.
Montia diffusa	Branching montia	S	Moist forests and open fir woodland in the lowland and lower montane zones (260–880 meters).
Ophioglossum pusillum	Adder's-tongue	S	Seasonally wet areas in pastures, roadside ditches, bogs, wet meadows, floodplains (10–1,000 meters). Often associated with lodgepole pine.
Oxytropis campestris var. *gracilis*	Yellowflower locoweed	D	Prairies, alpine meadows, open woodlands, and gravelly floodplains in moist or dry soils.
Packera bolanderi var. *harfordii*	Harford's ragwort	S	Bluffs and woodlands.[3]
Packera porteri	Porter's butterweed	S	Unglaciated nunatak (isolated mountain peaks); associated species include whitebark pine.
Pedicularis rainierensis	Mt. Rainier lousewort	D	Usually subalpine, moist meadows, open coniferous forests, and rocky slopes; often near streams.
Pellaea breweri	Brewer's cliff-brake	S	Open, rock alpine areas; crevices, ledges, and bases of cliffs and rock outcrops; often at south-facing aspects.
Pinus albicaulis	Whitebark pine	D	Often mixed with or adjacent to sagebrush or grassland communities.[4]
Platanthera chorisiana	Choris' bog-orchid	D	Wettest regions of sphagnum bogs, streams, seeps, wet meadows, gravel outwashes, and moist areas with fine soils; often just above the water table (774-1,300 meters).
Ranunculus cooleyae	Cooley's buttercup	D	Montane gravelly alluvial slopes, talus slopes, stream outlets, lake edges; generally on north-facing slopes.
Salix glauca var. *vilosa*	glaucous willow	S	Moist places, riparian areas, shrub wetlands, and gravelly open slopes, often above timberline (1,340-1,800 meters)
Salix sessilifolia	Soft-leaved willow	S	Wet lowland habitats including riverbanks, riparian forests, dredge spoils, and sandy beaches.

Scientific Name	Common Name	Documented (D) or Suspected (S) on the MBSNF	Habitat Requirements[1]
Scribneria bolanderi	Scribner's grass	D	Dry, sandy to rocky soils, seepages, vernal pools, and sometimes along roadsides (500-3,000 meters)
Sericocarpus rigidus	White-topped aster	S	Relatively flat, open grasslands of lowlands, usually in gravely, glacial outwash soils (10-170 meters).
Swertia perennis	Swertia	D	Little is known regarding habitat; one occurrence was found at 1,731 meters.
Utricularia intermedia	Flat-leaved bladderwort	S	Shallow ponds, slow-moving streams, and wet sedge or rush meadows (3-1,300 meters).

Source: USFS 2019 unless otherwise noted.
MBSNF = Mount Baker-Snoqualmie National Forest.
1 Habitat requirements from Camp and Gamon (2011) unless otherwise noted.
2 Catling and Magrath 2002.
3 Burke Herbarium Image Collection 2019.
4 USFS 2002.

4.6.6.3 Species Occurrence and Habitat Requirements on Fish and Wildlife Mitigation Lands

No additional vascular RTE plant species are mapped by WNHP within the fish and wildlife mitigation lands.

4.6.6.4 Federally Designated Critical Habitat

There is no known federally designated critical habitat for any threatened or endangered plant species potentially occurring within the Project Boundary or fish and wildlife mitigation lands.

4.6.7 Known or Potential Effects

4.6.7.1 Project-Related Effects

Potential effects on botanical resources from the Project O&M, or Project-related recreation include the following:

- **Effects of Reservoir Operations on Shoreline Erosion, Vegetation, and RTE Plant Species** – At Gorge and Diablo lakes, the combination of generally steep shoreline topography and relatively stable water levels throughout the year limits the establishment of emergent wetland vegetation. Erosion along sections of Ross Lake with steep slopes of unconsolidated material has been documented to have affected the adjacent upland habitats, where vegetation may be slow to reestablish. Project-related reservoir operations and prolonged seasonal inundation, as well as wave action (directly or indirectly related to the Project), may potentially be contributing factors to continuing erosion and for suppression of re-establishing vegetation. The characteristics of the erosion that has been documented within the three reservoirs are described further in Section 4.3 of this PAD. Another localized effect is the collection and storage of drift wood near the U.S.-Canada border and in other inlets of Ross Lake. The large volume of wood covers an approximately 1,500-foot-long section of the Ross Lake shoreline and may affect vegetation establishment. In the 2004-2007 time period, NPS conducted riparian restoration activities along several hundred feet of Ross Lake shoreline in Dry Creek bay. This work consisted of placing woody debris collected by City Light in the bay and using it as a planting substrate for a variety of native wetland plants (NPS 2006). The area treated totaled about 0.25 acre.

- **Effects of Invasive Plant Species on RTE Plant Populations and Habitat Species Diversity** – Invasive plants have the potential to impact RTE and other native plant populations and sensitive habitats within the Project Boundary and fish and wildlife mitigation lands outside the Project Boundary. This is because invasive species alter habitats and ecological processes and may have a competitive advantage over native plant species, particularly in areas of disturbance. In addition, invasive plant species populations, by definition, provide a source of propagules and can potentially spread to other areas. Within the Project Boundary, recreational sites, roadsides, trails, townsites, and reservoir drawdown areas support invasive plants and may aid their spread. Invasive plants have been documented within the RLNRA within the Project Boundary, along the transmission line, in townsites, and along the Skagit River downstream of the Project to the Sauk River confluence.
- Project operations may also affect the distribution of existing invasive species populations, particularly reed canarygrass that grow along shorelines. For example, in 2019, when Ross Lake was considerably below normal maximum water surface elevation, NPS observed more reed canarygrass in exposed portions of the drawdown area. NPS has also been treating large infestations in Big Beaver Valley that could have become established from seeds carried there by recreationists using the trail from Ross Lake or by animal seed dispersal.
- **Vegetation Management along the Transmission Line Corridor** – City Light manages vegetation within the transmission line corridor to meet NERC-required safety clearances from the high voltage lines and to remove danger trees adjacent to the corridor with the potential to grow into or fall onto the lines. While much of the corridor is managed using selective tree removals, some areas are periodically cut with heavy equipment mounted field deck or reticulated-arm flail brush cutters, and others receive periodic targeted herbicide application to control incompatible fast-growing tree species, such as black cottonwood, and noxious weeds. These maintenance activities may affect the spread of invasive species, reduce vegetation diversity, and affect RTE plant species. Invasive species are known to be present along the transmission line.
- **Recreation Use Effects on Vegetation** – Recreation use along the Project reservoirs has the potential to affect vegetation in general and possibly rare plants from boat mooring along the shore and foot traffic outside of designated campsites, day use areas, and trails.
- **Downstream Flow Alteration on Riparian Habitats and Wetlands –** Managed flow regimes from the Project may affect riparian and wetland hydrology and vegetation composition and structure by reducing flood flows, altering seasonal peak and low-flow magnitude and timing of the Skagit River. Wetland and riparian zones are generally in good condition in most locations but there are likely species and age class effects in some areas. In addition, long term changes to the riverine geomorphology, such as increased channelization, may have impacted the extent of these habitats in some locations.
- **Wildfire Management Effects on Vegetation** – City Light coordinates with NPS on wildfire management to protect Project facilities. Over the long-term, suppression of wildfires, some

of which is to protect Project facilities and management of vegetation immediately adjacent to facilities (e.g., FireWise Program), affects the type, density, and distribution of plants within and near the fire suppression zone.

4.6.7.2 Cumulative Effects

Most of the portion of the Project Boundary within the RLNRA include City Light facilities and a variety of recreation sites and transportation infrastructure. Some types of development associated with the Project may combine with the past, present, and reasonably foreseeable future actions of other entities to produce the following cumulative effects on botanical resources:

- The RLNRA General Management Plan (GMP) states that the park is facing a need for increased capacity and that changes to park facilities and management will be necessary to accommodate increases in visitors (NPS 2012). Upgrades to NPS facilities to accommodate increased public demand, such as new boat launches, parking, or other visitor facilities, may increase development along the reservoirs and Skagit River. These developments could result in damage to native vegetation or the introduction of invasive nonnative plants, which in combination with the existing Project-related recreational use could contribute to cumulative effects on botanical resources.
- The RLNRA GMP also states that climate change is an increasing concern for fire management. Management actions to address fire concerns, such as thinning around facilities and campgrounds, could alter native vegetation, which in combination with existing Project-related vegetation management could result in cumulative effects on plant species composition, structure, and cover.
- Mining on any of the many claims within or near the Project Boundary could, in combination with the effects of the Project, result in cumulative effects on botanical resources, increasing net losses of vegetation in the Project vicinity. For example, Kiewit Infrastructure Co. owns a site near Marblemount that could be developed into a large rock quarry. The proposed project would be located immediately adjacent to the Illabot South and South Marble 40 wildlife mitigation lands on Rockport-Cascade Road near Marblemount.
- Increased recreational use of the Skagit River corridor, such as guided tours, rock climbing, cycling, horseback riding, in combination with Project-related recreation, has the potential to affect sensitive botanical resources and degrade habitat to create areas suitable for colonization by invasive plant species.
- Timber harvest on private lands near fish and wildlife mitigation lands and adjacent to the Project's transmission line will likely continue and could accelerate. Combined with Project-related vegetation management within the ROW, clearcutting and harvesting on adjacent private lands could increase the likelihood of introducing noxious weeds, thereby degrading habitat required by sensitive plant and other species.

4.6.8 Existing or Proposed Protection, Mitigation, and Enhancement Measures

4.6.8.1 Existing Measures

There were no specific articles or PME measures in the current Project license that specifically addressed botanical resources. However, over the years, City Light has collaborated with agencies, tribes, and NGOs to identify and implement measures to protect and benefit botanical resources in the Project vicinity. These include the following:

- Land acquisition – Through approval of the Land Acquisition Group and WMRC established by the license and WSA, City Light purchased parcels for the fish and wildlife mitigation lands. Currently, City Light owns a total of approximately 10,850 acres of fish and wildlife mitigation lands. Lands acquired and managed under this program are primarily used to address effects on terrestrial wildlife habitat and are strategically chosen to protect floodplains and protect riparian and forested corridors by abutting already protected lands (e.g., federal, state, TNC, etc.). There are corresponding benefits to botanical resources from preservation and management of these lands. Management priorities have included the protection of old-growth forests, restoration of riparian and wetland habitats, creation and maintenance of elk forage areas, removal of stream culverts, and removal of rip-rap from riverbanks. Additionally, the removal of roads and the control of vehicular access to these sites reduced the spread of weeds on these lands. Remaining funds in this program are being used on management implementation through the end of the current FERC license period (see Section 4.7.7 of this PAD for details of funding over the term of the current FERC license).
- Weed management – City Light manages noxious weeds and other invasive plant species on lands owned by City Light, as well as federal lands near Project facilities, to comply with applicable state and county weed laws and assist with NPS management objectives.
- Concerted efforts of weed control and riparian habitat restoration on the Project have been ongoing since 2014. City Light, in partnership with NPS, Upper Skagit Indian Tribe, SRSC, SFEG, and the Washington Conservation Corps (part of Ecology), creates annual strategies for habitat restoration and invasive plant management throughout the Project vicinity.

4.6.8.2 Proposed Measures

City Light proposes to develop updated vegetation management plans that will address townsites, transmission line corridors, and fish and wildlife mitigation lands. The plans will address RTE plant protection; invasive species management; and protection of streams, wetlands, riparian areas, and other priority habitats. City Light will develop a comprehensive Transmission Line Corridor Management Plan that includes BMPs to protect natural and cultural resources from direct and indirect impacts from Project O&M activities as well as indirect impacts due to recreational use of City Light roads and trails. City Light also proposes to collaborate with NPS on a Wildfire Management Plan that will address fire prevention and response as well as fuel management topics.

4.7 Wildlife Resources

This section describes the general habitat features associated with the Project vicinity and the wildlife that is documented or expected to occur there. In this section, Project vicinity is defined as the Project structures and reservoirs, transmission line ROW from the powerhouses to Bothell Substation, Gorge bypass reach, Marblemount and Sauk River boat launches, and the fish and wildlife mitigation lands in the Skagit, Sauk, and South Fork Nooksack watersheds. See Figure 3.4-28 in Section 3 of this PAD for locations of the fish and wildlife mitigation lands.

Information on potential wildlife use of the Project vicinity is based on the literature on species/habitat associations; observations by City Light biologists; and surveys conducted by NPS biologists in the North Cascades National Park Complex and WDFW, tribal, and British Columbia Ministries of Parks biologists elsewhere in the Project vicinity. Resources consulted for this section include, but are not limited to:

- City Light FERC compliance reports for terrestrial resources and anecdotal observations
- NPS studies, monitoring reports, and anecdotal observations
- British Columbia Parks studies
- City Light-funded wildlife studies
- WDFW Priority Habitats and Species (PHS) database
- WDFW species reports and management plans
- USFWS reports and plans
- Study reports from the previous FERC relicensing process for the Skagit River Project
- Scientific publications

Information on wildlife occurrence within the North Cascades National Park Complex is available from a variety of NPS studies. These studies mostly concentrate on areas within the National Park, but occasionally include survey points in the RLNRA, including the Project Boundary. Limited site-specific data on wildlife occurrence are available for habitats along the transmission line ROW or within the fish and wildlife mitigation lands. Available sources or general habitat-species relationships are used to report on these portions of the Project Boundary or vicinity.

4.7.1 Wildlife Populations

The Project Boundary spans two Ecoregions. The Project reservoirs, a small portion of the transmission line corridor, and some of the mitigation lands lie within the North Cascades Ecoregion that encompasses the Cascade Mountains and foothills in Washington. Most of the transmission line corridor and the mitigation lands lie within the Puget Trough Ecoregion, which generally includes land up to 1,000 feet in elevation around Puget Sound.

The North Cascades Ecoregion provides habitat for 319 wildlife species, including 9 amphibians, 12 reptiles, 222 birds, and 76 mammals (Washington Biodiversity Project 2019). The forests in the ecoregion, including those in the Project vicinity, support a variety of wildlife species, such as black-tailed deer (*Odocoileus menonus*) and black bear (*Urus americanus*). Alpine and sub-alpine habitat in the ecoregion, which occur above 4,000 feet elevation west of the Cascade crest, support several species that are relatively uncommon in Washington, including wolverine (*Gulo gulo*), Canadian lynx *(Lynx canadensis concolor*), mountain goat (*Oreamnos americanus*), and white-tailed ptarmigan (*Lagopus leucura*). The Project Boundary is below elevation 2,000 feet and contains no alpine or subalpine habitat.

Most of the transmission line and the fish and wildlife mitigation lands are within the Puget Trough Ecoregion. This Ecoregion is inhabited by 74 mammal species, 29 species of amphibian and reptiles, and 163 species of birds. Vegetation within the transmission line corridor likely supports a less diverse assemblage of native wildlife species than is present in less disturbed habitats found on the wildlife mitigation lands. The occurrence of species groups is described in more detail in Section 4.7.2 of this PAD.

4.7.1.1 Reptiles and Amphibians

Six reptile species may occur within the Project Boundary (Table 4.7-1). The two species not recorded within the RLNRA may occur at lower elevations on wildlife lands or along the transmission line ROW (Rawhouser et al. 2009; NPS 2019b). Western fence lizard (*Sceloporus occidentalis)*, for example, occurs east of the Cascade crest in the North Cascade National Park but has a disjunct distribution in Washington, is also present in the Puget Sound lowlands, and may occur in the vicinity of the western extent of the transmission line corridor (Rawhouser et al. 2009; Brown et al. 1995; Natureserve 2019). Northern alligator lizards are frequently observed in the rocky habitats around Gorge Powerhouse and in the powerhouse itself (McShane 2019).

Table 4.7-1. Reptile species that may occur within the Project Boundary.

Common Name	Scientific Name	RLNRA	Wildlife mitigation lands or transmission line
Northern alligator lizard	*Elgaria coerulea*	X	X
Western fence lizard	*Sceloporus occidentalis*		X
Rubber boa	*Charina bottae*	X	X
Northwestern garter snake	*Thamnophis ordinoides*		X
Western terrestrial garter snake	*Thamnophis elegans*	X	X
Common garter snake	*Thamnophis sirtalis*	X	X

Source: Brown et al.1995; NPS 2019a.

Twelve amphibian species have been recorded within the RLNRA (Table 4.7-2). Any of these species may occur within the Project Boundary, and some may be more abundant in the lower elevation section of the transmission line corridor and on the fish and wildlife mitigation lands. No non-native amphibians have been recorded in the North Cascades National Park Complex (NPS 2019b). The American bullfrog (*Rana catesbeianus*), a non-native species, may occur along the transmission line in low elevation ponds or on the fish and wildlife mitigation lands, but none have been recorded to date.

NPS studies and City Light surveys from 2011 and 2012 of the wildlife mitigation lands with wetlands provide data on amphibian occurrence. Some of the NPS sample sites included the Project Boundary, but only observations of coastal tailed frog (*Ascaphus truei*) and coastal giant salamander (*Dicamptodon tenebrosus*) were mapped. Other species are listed as incidental observations within the North Cascades National Park Complex without specific locations (Rawhouser et al. 2009). Occurrence of giant salamander was not documented within the Project Boundary, but tailed frogs were found in several tributaries to Ross Lake and within the lower reach of Sourdough Creek, which flows into Diablo Lake. Ensatina (*Ensatina eschscholtzii*), northern red-legged frog (*Rana aurora*), and western toad (*Anaxyrus boreas*) have been observed near Newhalem and the Park Slough spawning channel (Rawhouser et al. 2009). Large breeding occurrences of red-legged frog (Figure 4.7-1) and individual occurrences of northwestern salamander, Pacific tree frog, and long-toed salamander have been observed within the Project Boundary around Ross Lake. Bullfrogs have not been observed anywhere within the Project Boundary (Tressler 2019).

The fish and wildlife mitigation lands that contain wetlands and streams provide substantial amphibian habitat, such as what occurs on the Savage Slough and Barnaby Slough parcels.

Table 4.7-2. Amphibian species that occur within the Project Boundary.

Common Name	Scientific Name	RLNRA	Wildlife mitigation lands or transmission line
Western toad	*Anaxyrus boreas*	X	X
Pacific tree frog	*Pseudacris regilla*	X	X
Coastal tailed frog	*Ascaphus truei*	X	X
Northern red-legged frog	*Rana aurora*	X	X
Cascades frog	*Rana cascadae*	X	X
Columbia spotted frog	*Rana luteiventris*	X	X
Northwestern salamander	*Ambystoma gracile*	X	X
Long-toed salamander	*Ambystoma macrodactylum*	X	X
Coastal giant salamander	*Dicamptodon tenebrosus*	X	X
Ensatina	*Ensatina eschscholtzii*	X	X
Western red-backed salamander	*Plethodon vehiculum*	X	X
Rough-skinned newt	*Taricha granulosa*	X	X

Source: Jones et al. 2005; NPS 2019a; Tressler 2019.

Batrachochytrium dendrobatidis (Bd), a pathogenic fungus associated with the disease chytridiomycosis in amphibians, was not detected in samples of coastal tailed frog larvae, long-toed salamanders (*Ambystoma macrodactylum*), coastal giant salamanders, or western toads found in stream and riparian sites within six miles of Ross, Diablo, and Gorge lakes, and the Skagit River downstream of the Project (Grummer and Leache 2016). Bd has not been detected in amphibians in Whatcom, Skagit, or Snohomish counties, but has been detected in King County (Brady et al. undated.). Thus, it has not been detected in the Project vicinity.

Figure 4.7-1. Red-legged frog in wetland at Illabot North Wildlife Land, 2009.

4.7.1.2 Birds

NPS has a database that includes 222 bird species that have been observed in the North Cascades National Park Complex. Seventy-three of these are listed as species of concern for the park. These include those listed as Management Priority on the NPS species website (NPS 2019a) or identified as focal species for conservation strategies developed by Partners in Flight and the North American Bird Conservation Initiative (Partners in Flight 2016).

A study on birds in the North Cascades National Park Complex recorded 116 species (Siegel et al. 2009). Intensive surveys at Thunder Creek, Big Beaver Creek, Stiletto, and McCalester sites recorded 32, 31, 26, and 22 species, respectively. Birds observed within the Project Boundary include common loon (*Gavia immer*), harlequin duck (*Histrionicus histrionicus*), northern goshawk (*Accipiter gentilis*), common raven (*Corvus corax*), three chickadee species, two wren species, Vaux's swift (*Chaetura vauxi*), nine species of warbler, and mountain bluebird (*Sialia currucoides*), among others (Siegel et al. 2009). NPS data (Holmgren et al. 2015) indicated that the five most frequently detected species in the North Cascades National Park Complex were: pine siskin (1,221 detections), dark-eyed junco (877 detections), varied thrush (770 detections), Pacific wren (648 detections), and Townsend's warbler (574 detections).

There have been no surveys of birds near the generation facilities, along the transmission line ROW, in City Light townsites, or on the mitigation lands. However, incidental observations by City Light biologists suggest that violet green swallows (*Tachycineta thalassina*), barn swallows (*Hirundo rustica*), American robins (*Turdus migratorius*), cedar waxwings (*Bombycilla cedrorum*), and Steller jays (*Cyanocitta stelleri*) are common in Diablo and Newhalem during the summer, as are the non-native house sparrow (*Passer domesticus*), house finch (*Haemorhous mexicanus*), and starling (*Sturnus vulgaris).* Warbler, vireo, thrush, and kinglet species are often seen or heard in the forested habitats surrounding Project facilities. Canada geese (*Branta canadensis*) and common merganzers (*Mergus merganser*) are frequently observed on the reservoirs; saw whet owls (*Aegolius acadicus*), barred owls (*Strix varia*), and piliated woodpeckers (*Dryocopus pileatus*) have been noted across the river from Newhalem along the Trail of the Cedars. Rufous hummingbirds (*Selasphorus rufus*) are very common in the Project vicinity in early spring where they utilize salmonberry and red-flowering current in natural habitats and cherry trees in the Newhalem landscape. Three of the fish and wildlife mitigation parcels – Barnaby Slough, County Line Ponds, and Newhalem Ponds – are well known within the birding community for the opportunities they provide for viewing a variety of waterfowl and passerines during the breeding season (McShane 2019). A range of waterfowl have been observed in the Barnaby Slough section of the Project Boundary including, but not limited to, bufflehead (*Bucephala albeola*), double-crested cormorant (*Phalacrocorax auritus),* hooded merganser (*Lophodytes cucallatus*), pied-billed grebe (*Podilymbus podiceps*), trumpeter swan (*Cygnus buccinators*), and ring-necked duck (*Aythya collaris*) (City Light 2013).

During studies conducted in the late 1980s for the last relicensing, the osprey was a species of significant concern in the RLNRA and very few occurred in western Washington. Since then, osprey populations have greatly expanded throughout the state, including the Project vicinity. The species nests in several locations along Ross Lake, along the Skagit River downstream of the Project, and on multiple transmission towers (McShane 2019).

4.7.1.3 Mammals

A total of 77 mammal species have been recorded in the North Cascades National Park Complex. Commonly observed species include black-tailed deer, pine marten (*Martes americana*), black bear, several bat species, pika (*Ochotona princeps*), snowshoe hare (*Lepus americanus*), deer mouse (*Peromyscus maniculatus*), hoary marmot (*Marmota caligata*), Townsend's chipmunk (*Tamias townsendii*), and Douglas squirrel (*Tamiasciurus douglasii*), among others (Hoffman et al. 2015).

Pikas make use of talus patches along the Project reservoirs and along the transmission line between Newhalem and Bacon Creek. There is an increasing concern that reduced snowpack from climate change may affect pika populations throughout the western United States (Beever et al. 2016). A study of pika in the North Cascades National Park Complex determined that populations at mid- to higher elevations (>0.5 miles) were abundant. The risk of climate change affecting pika populations were greatest at lower elevations because the animals already face higher summer temperatures and lower quality forage. Continued temperature increases and precipitation changes from climate warming may result in conditions that are not suitable for pika survival at low elevations in North Cascades National Park Complex (Bruggeman 2010).

Sizable bat maternity colonies, mostly Yuma myotis (*Myotis yumanensis*), occur at Hozomeen warehouse (Christophersen and Kuntz 2003) and were previously found in several Newhalem and Diablo house attics. An exit survey conducted in 2009 at a house in Newhalem counted over 500 bats. Because these homes were occupied by City Light staff, access for the bats was eliminated after the bats left in the fall. City Light has installed bat houses in Newhalem and Diablo and a bat condo at Hozomeen, which are used by *Myotis* spp. A silver-haired bat was found on vegetation along the shoreline of the Skagit River just downriver from the Diablo Powerhouse tailrace in 2019 by a City Light biologist. City Light collaborated with NPS and WDFW to test guano collected at Newhalem for the bacterium that causes white-nose syndrome and the results were negative (Tressler 2019). A variety of bat species have been detected on the Barnaby Slough wildlife mitigation land including California myotis (*M. californicus*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), hoary bat (*Lasiurus cinereus*), long-eared myotis (*M. evotis*), little brown myotis (*M. lucifugus*), and possibly long-legged myotis (*M. volans*) (City Light 2014).

Elk, beaver, black-tailed deer, and black bear are regularly observed around the City Light townsites and facilities around Newhalem.

Of the more than 70 species of mammals documented in the North Cascades National Park, evidence suggests that gray wolf (*Canis lupus*), wolverine, Canada lynx (*Lynx canadensis*), and moose (*Alces alces*), have a widespread but irregular occurrence (see details in Section 4.7.2 of this PAD). Mammal distribution and abundance are dependent on many factors including forest seral stage, aspect, level of habitat disturbance, and elevation (Weber et al. 2009).

4.7.2 Rare, Threatened, and Endangered Wildlife Species

This section describes species that potentially occur within the Project vicinity and that are included on any one of the following lists. In addition to the lists below, NPS maintains an extensive list of Management Priority Species that are categorized as "species that warrant particular management attention as determined by park management staff." However, given that this list is quite comprehensive and is less focused than the categories below, it is not included here:

- **ESA Federally Listed or Proposed Species** – Species that are listed and protected under the ESA of 1973, as endangered or threatened, or proposed for listing.
- **ESA Candidate Species** – USFWS has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation has not occurred because of other higher priority listing activities. Candidate species receive no statutory protection under the ESA. However, USFWS encourages the formation of partnerships to conserve these species.
- **ESA Federal Species of Concern** – Species that do not have protection under the ESA but that are of management concern to USFWS.
- **State-Listed Species** – Species that are protected by the State of Washington (WAC 220-610-110). State endangered species include "a species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state." State threatened species include any "species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats." State sensitive species are defined as "a species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats" (WDFW 2019a).
- **USFS Sensitive Species** – Species on the Regional Forester's List of Sensitive Species for the Mt. Baker-Snoqualmie National Forest (USFS 2004). The Regional Forester's List does not include species already protected under the ESA.

Table 4.7-3 summarizes the occurrence of RTE wildlife in the Project vicinity.

Table 4.7-3 Wildlife species with federal or state status within the Project vicinity.

Species	WDFW[1]	USFS[2]	USFWS[3]	Habitat Use	Project Vicinity Occurrence
Western toad (*Anaxyrus boreas*)	C			Variety of upland habitats; slow-moving waters, particularly wetlands for egg deposition and larval development	Documented near Newhalem and in tributaries to Ross Lake and at various locations along the Skagit River.
Columbia spotted frog (*Rana luteiventris*)	C			Ponds, seeps, and wetlands.	Documented in tributaries to Ross Lake and in Skagit Valley Provincial Park.
Oregon spotted frog (*Rana pretiosa*)	E		T	Lakes and ponds of lowland Puget Sound in WA. Rarely strays from water.	Samish River drainage. Recently detected in upper Skagit watershed in British Columbia.

Species	WDFW[1]	USFS[2]	USFWS[3]	Habitat Use	Project Vicinity Occurrence
Common loon (*Gavia immer*)	S	S		Nests on edges of remote lakes and ponds.	Regularly observed feeding in Ross and Diablo lakes. Nests on nearby Hozomeen Lake.
Marbled murrelet (*Brachyrampus marmoratus*)	E		T	Nests in old-growth forests.	One recent observation on Ross Lake. Radar detections near Thornton and Bacon creeks downriver from Newhalem.
Northern spotted owl (*Strix occidentalis*)	E		E	Nests in old-growth forests; second-growth used for dispersal.	Historical breeding near Project Boundary, but no recent documented pairs. Closest pair was 2 miles upstream from Newhalem Creek diversion.
Harlequin duck (*Histrionicus histrionicus*)		S		Nests along fast-moving mountain streams.	Documented on the Skagit River in B.C. and larger tributaries to Ross and Diablo Lakes and Newhalem Creek.
Northern goshawk (*Accipiter gentillis*)	C	S		Old-growth and mature forests.	Documented use in Project Boundary in vicinity of Diablo Powerhouse
Bald eagle (*Haliaeetus leucocephalus*)		S		Nests and forages along lakes and rivers.	Heavy use in winter feeding on Chum Salmon between Newhalem and Rockport. Several nests along Ross lake and the Skagit River.
Peregrine falcon (*Falco peregrinus*)		S		Nests on cliffs, forages in open areas.	Up to 6 pairs documented nesting on cliffs in recent years: three areas along Ross Lake, one near Diablo Dam, two sites near Gorge Lake, and one site north of Gorge Powerhouse.
Townsend's big-eared bat (*Corynorhinus townsendii*)	C	S		Roosts in caves, buildings, and natural cavities.	No documented occurrences.
Little brown myotis (*Myotis lucifugus*)		S		Roost in buildings, under bridges, in cavities.	Documented – roosts in older buildings.
Fisher (*Pekania pennant*)	E		PT	Forests and subalpine habitats of Cascades.	NPS participating in reintroduction to the North Cascade National Park Complex and Skagit and Sauk River watersheds.
Wolverine (*Gulo gulo*)	C	S	PT	Alpine and subalpine habitats.	Scattered records; 2012 record west of Project vicinity; spring 2019 observation along Ross Lake shoreline.

Species	WDFW[1]	USFS[2]	USFWS[3]	Habitat Use	Project Vicinity Occurrence
Grizzly bear (*Ursus arctos*)	E		T	Valley bottoms, high meadows, forest edge, and thickets.	Rare, scattered historical observations.
Canada lynx (*Lynx canadensis*)	E		T	Subalpine and boreal forests, typically higher than 4,500 feet.	Uncommon but several recent observations within the North Cascade National Park Complex near Hozomeen; 2019 individual at Diablo Lake and near Agg Ponds west of Newhalem.
Gray wolf (*Canis lupus*)	E		E (west of Cascade crest)	Highly adaptable where ungulate prey is available. Forests, river valleys, open spaces.	Recent confirmation of a newly formed pack centered around Diobsud Creek that includes the west edge of the North Cascade National Park Complex and overlaps portions of the transmission line corridor and fish and wildlife mitigation lands. Occurrence also documented along Ross Lake north of Lightning Creek.
Mountain goat (*Oreamnos americanus*)		S		Cliffs and crags of the alpine and subalpine zone.	Common in alpine zone North Cascade National Park Complex, use of lower elevations of Project Boundary in winter, including cliffs above Newhalem and Gorge bypass reach and along east side of Ross Lake.

Source: Aubry et al. 2007; Braaten 2019; Christophersen 2016; Christophersen and Kuntz 2003; eBird 2019; Freeman and Goudie 2002; Hamer Environmental 2009; Hoffman et al. 2015; Kuntz and Christophersen 1996; North Cascades National Park Complex 2019; Ovaska et al. 2019; Ransom 2019; Rawhouser et al. 2009; Rice 2005; Tressler 2019; WDFW et al. 2019.

1 WDFW: C=candidate, S=sensitive, E=endangered.
2 USFS: S=sensitive.
3 USFWS: T=threatened, E=endangered, PT=proposed threatened.

4.7.2.1 Species Occurrence and Habitat Requirements

The following narrative briefly describes the RTE wildlife species with federal protection under the ESA that may occur within the Project vicinity, habitat requirements, and notes on documented observations.

Oregon Spotted Frog

The Oregon spotted frog (*Rana pretiosa*) is a Pacific Northwest endemic species historically distributed from southwestern British Columbia to northeastern California in the Puget Trough-Willamette Valley and East Cascades-Modoc Plateau ecoregions (Hallock 2013). The species was listed as a threatened species on August 29, 2014 (79 FR 51658). These frogs are generally associated with wetland complexes larger than 10 acres with extensive emergent marsh coverage that warms substantially from spring to fall. Current occurrences in Washington are in the Sumas River (Whatcom County), Black River drainage (Thurston County), lower Trout Lake Creek drainage, and at Conboy Lake and Camas Prairie in the Outlet Creek drainage (Klickitat County) (Hallock 2013). Surveys from 2001-2013 indicate the occurrence of Oregon spotted frog in the Samish River drainage of western Skagit County and the lower South Fork Nooksack River drainage in Whatcom County (Bohannon et al. 2016).

The species has not been documented in the North Cascades National Park Complex, but recent work in the Skagit Basin in British Columbia indicates that the species is found in the upper watershed. DNA of Oregon spotted frog was detected, along with DNA of Columbia spotted frog, at one wetland less than three miles north of the U.S.-Canada border in the Skagit Valley Provincial Park, indicating the presence of the species (Ovaska et al. 2019).

In 2011, City Light surveyed for Oregon spotted frogs and egg masses in the fish and wildlife mitigation lands wetlands; none were observed (Tressler 2019). The species has not been documented around the Project reservoirs and has not been observed in the fish and wildlife mitigation lands. Much of the transmission line traverses forested or industrial timber lands, or at the more western reaches, across agricultural land in a region of western Washington where no spotted frogs have been documented.

Marbled Murrelet

The marbled murrelet (*Brachyrampus marmoratus*) is a small seabird that nests in coniferous forests and forages in coastal waters. The species was federally listed as threatened in 1992 due to a loss of breeding habitat and mortality associated with gill net fishing and oil spills (57 FR 45328). At-sea breeding population estimates for marbled murrelets in Puget Sound and the Strait of Juan de Fuca fluctuated from 2000 through 2008, with no discernable increasing or decreasing trend (Lance and Pearson 2016). A review of its status by USFWS found that the California/Oregon/Washington marbled murrelet population is a DPS that continues to be subject to a broad range of threats, such as nesting habitat loss, habitat fragmentation, and predation (USFWS 2009; USFWS 2019c). Based on this assessment, USFWS concluded in January 2010 that removing the species from the list of threatened species is not warranted (75 FR 3424).

The distance inland that marbled murrelets breed is variable and is influenced by several factors, including the availability of suitable habitat, climate, topography, predation rates, and maximum forage range (McShane et al. 2004). In Washington, the primary nesting range extends 40 miles inland, but occupied nesting habitat has been documented 52 miles from the coast (Hamer 1995; Madsen et al. 1999), and the species has been detected up to 70 miles inland (57 FR 15328). However, 90 percent of all observations have been within 37 miles of the coast in the northern Washington Cascades (57 FR 15328). Marbled murrelets typically nest in old-growth forests and select large, old trees with branches that support mats of epiphytes (McShane et al. 2004). Nesting in Washington occurs over an extended period from late April through late August (McShane et al. 2004). Incubation lasts about 30 days and chick rearing takes another 28 days.

The Gorge Powerhouse is 54 miles straight-line distance from Puget Sound, which is just beyond the 50-mile zone generally considered to be the farthest distance from saltwater for murrelet nesting habitat in Washington (USFWS 1997). Nonetheless, the Project vicinity does contain some suitably large trees and could possibly be used by murrelets for nesting. The fish and wildlife mitigation lands at Illabot Creek, Bacon Creek, and South Fork Nooksack and forests adjacent to the transmission line also contain some patches of large conifer trees that could provide potential habitat, although no formal assessment has been conducted because no habitat modifying projects have been conducted by City Light. These parcels range from 20-45 miles from Puget Sound. An assessment of a small portion of the Nooksack parcel found a patch of trees >32 inches diameter at breast height (dbh) with potentially suitable nest platforms based on Washington DNR survey methodology (letter from G. Bell, WDFW Wildlife Biologist to R. Tressler, City Light Wildlife Biologist, August 12, 2013).

In May and June 2008, pre-dawn radar surveys recorded detections of possible marbled murrelets flying along the Skagit River near the mouths of Bacon, Thornton, and Damnation creeks (Hamer Environmental 2009). The Thornton Creek survey site is approximately two miles from the Gorge Powerhouse. Eleven of the flight path detections were very close to the Bacon Creek mitigation lands, but all were high-speed flights indicative of birds passing through as opposed to flights near nest sites. Follow-up ground-based surveys in 2009 detected murrelet-like audio-visual observations 1.5 miles up the Thornton Creek drainage but failed to detect any possible murrelet activity at survey stations 4.6 miles up the Bacon Creek drainage (Hamer Environmental 2009). Additional survey effort would be necessary to verify actual murrelet use in these drainages.

Surveys for marbled murrelets have not been conducted on Gorge, Diablo, or Ross lakes. NPS records show few visitor or staff sighting records of this species in the RLNRA. However, NPS staff observed a pair of murrelets on Ross Lake in 2017, near Roland Point (Ransom 2019). Murrelets have been documented foraging on inland freshwater lakes in Alaska, Washington, and Oregon. In Washington they have been documented using Lake Washington near Seattle and Lake Quinalt on the Olympic Peninsula. In British Columbia, most freshwater lakes used by murrelets were within 12 miles of the coast, but use did extend to inland lakes up to 46 miles from the coast (Carter and Sealy 1986).

Northern Spotted Owl

The northern spotted owl (*Strix occidentalis*) was federally listed as threatened in June 1990 (65 FR 5298-5300), with the final recovery plan for the species published in May 2008 and revised in 2011 (USFWS 2011). In Washington, spotted owls typically nest in older, multilayered forests at elevations from near sea level to 4,000 feet in the North Cascades. Dense forested areas are used for daytime roosting, and roosting and nesting sites are typically within a few hundred yards of one another (USFWS 2008). Populations of spotted owls in Washington are thought to have declined precipitously since 1990; however, the current number of occupied territories is unknown because not all areas have been or can be surveyed annually (USFWS 2008).

The primary threats to northern spotted owls are habitat loss and fragmentation, increased human disturbance, and predation and inter-specific competition with barred owls. There is evidence that increased barred owl populations have reduced spotted owl site occupancy, reproduction, and survival (USFWS 2008). In areas where barred owls have become more common than spotted owls, such as in the western North Cascades, barred owls out-compete spotted owls (Herter and Hicks 2000). Hybridization between the two species is also a major threat to spotted owls (USFWS 2011).

Historical surveys of the Ross Lake drainage found no spotted owls, only barred owls, northern pygmy owls, and a great horned owl (Bjorklund and Drummond 1987). Spotted owls were surveyed on 20 nights using broadcast calling along 140-mile transects in the Skagit River watershed of British Columbia by Forsman and Booth (1986). There were 3 spotted owl responses documented while 27 barred owls responded. The spotted owl sites were old-growth Douglas-fir, western hemlock, western red cedar, and silver fir. No spotted owl pairs were detected, while eight pairs of barred owls were detected. The authors concluded that the spotted owl was extremely rare in the upper Skagit River at the time of the survey and has probably declined from historical numbers.

The North Cascades National Park Complex was surveyed for northern spotted owls in 1993-1996 (Kuntz and Christophersen 1996), and this effort located 11 spotted owl activity sites (six occupied by pairs, five occupied by single birds). The Institute for Bird Populations (IBP) re-surveyed these 11 historical sites in 2009-2010 with only one detection in the upper Newhalem Creek drainage in 2009. A single spotted owl was observed during the 2010 field season by a NPS Wilderness Ranger near Pyramid Lake (Siegel et al. 2012). Since 2010, the NPS has intermittently surveyed specific sites associated with compliance needs related to specific projects. Over the past few years spotted owls have been detected at Newhalem Creek and Colonial Creek, as well as in few areas near Ross Lake (Ransom 2019). The Goodell Creek fire of 2015 likely affected old growth stands and potential spotted owl habitat, especially in the Newhalem Creek drainage.

Survey results suggest that barred owls have colonized forests that have been managed as wilderness for many decades (Siegel et al. 2012). By the early 1990s, barred owls had already become well established in lower elevation habitats throughout the North Cascades National Park Complex (Siegel et al. 2012). Kuntz and Christophersen (1996) detected barred owls approximately as frequently as spotted owls east of the Cascades crest, and eight times as frequently on the west side of the crest. Surveys conducted in 2008 in the Skagit River basin near Baker Lake (which is about 18 miles northwest of Newhalem) failed to document any active spotted owl territories but did confirm 11 breeding pairs of barred owls (Hamer and Verschuyl 2009). The surveys conducted by the IBP in 2009–2010 near historical spotted owl territories in the Newhalem Creek, Panther Creek, Ross Lake, Big Beaver Creek, Little Beaver Creek, Ruby Creek, and Thunder Creek drainages in the RLNRA detected numerous barred owls (34 activity sites) (Siegel et al. 2012).

Grizzly Bear

Before the arrival of Europeans, grizzly bears (*Ursus arctos*) occupied much of the western U.S., central Mexico, western Canada, and most of Alaska. By the 1930s, the species was eliminated from all but two percent of its historical range (USFWS 1993). The species was listed as threatened under the ESA on July 28, 1975. An assessment by Almack et al. (1993) concluded that adequate habitat was available in the North Cascades to support grizzly bears. Following three years of DNA hair-snare sampling, researchers determined that a population of six bears occupied the North Cascades Ecosystem of Washington and British Columbia (Romain-Bondi et al. 2004). A bear thought to be a grizzly bear was photographed near Cascade Pass in the North Cascades National Park Complex in October 2010. Subsequent review of the photograph by experts left the validity of the sighting in question and the siting is listed as “uncertain.” The most recent confirmed sitings of grizzly bears in the North Cascades Ecosystem have been in British Columbia in the Skaist Creek and adjacent drainages in or next to the upper Skagit River (Braaten 2019).

In 2011, USFWS estimated that fewer than 20 bears occupied the North Cascades Ecosystem, which includes northwest and north-central Washington and extends into Canada. A camera station in Manning Provincial Park in the upper Skagit River watershed as part of the Cascades Wolverine Project captured photographs of a grizzly bear in 2010 and 2012 (U.S. Department of the Interior [USDOI] 2017). The most recent confirmed observation within the U.S. portion of the North Cascades Ecosystem was in 1996, south of Glacier Peak (IGBC NCE Subcommittee personal communication 2016, cited in USDOI 2017).

There are no current data regarding population size, trend, survival, or reproductive rates for grizzlies in the North Cascades of Washington (WDFW 2013). The natural recovery of grizzly bears is unlikely due to the demographic and environmental stochastic events associated with small populations (Romain-Bondi et al. 2004). The Project Boundary is not mapped as core grizzly bear habitat, but most of the Project Boundary in Whatcom and Skagit counties is surrounded by core habitat.

USDOI is considering the possibility of reintroducing grizzly bears to the North Cascades. USDOI and USFWS developed a NEPA Environmental Impact Statement regarding this action and recently reopened the comment period, which ends on October 24, 2019.

Canada Lynx

The Canada lynx was state listed as threatened in Washington in 1993 and federally listed as threatened in 2000. Primary threats to the species include habitat loss and overutilization (trapping) (65 FR 16051). In November 2006, USFWS designated critical habitat for lynx east of the Cascade crest within Chelan County above the 4,000-foot elevation (71 FR 53355). Critical habitat is well outside the Project vicinity. Lynx are closely associated with boreal forests because of their near-dependence on a single prey species—the snowshoe hare—which is mostly limited to this habitat type (Stinson 2001).

In Washington, Canada lynx are primarily found in high-elevation forests in the north-central and northeast part of the state, including subalpine and high-elevation mixed conifer zones in the Cascades generally above 3,600 feet. In 2008, the Canada lynx population in Washington was estimated at 87 individuals, with the highest concentration in the Okanogan-Wenatchee National Forest portion of the North Cascades Ecosystem. Revised estimates of female home range sizes in 2015 suggest that the carrying capacity for female lynx has declined from 43 in 1996 to 27 in 2014 (Lewis 2016).

Lynx observations have been noted on wildlife observation cards in the Stehekin Valley and along SR 20. Remote cameras detected lynx in the Hozomeen area, near the U.S.-Canada border in the winter of 2011/2012 (Hoffman et al. 2015). In the winter of 2019, lynx were observed on the ice of Diablo Lake (Ransom 2019) and near the Newhalem Ponds Storage Area on City Light land just downstream of Newhalem (Tressler 2019).

Gray Wolf

Gray wolves in Washington were classified as endangered until 2011 when the federal government ended federal protection for wolves in the eastern third of the state but maintained protection for wolves in the rest of the state. WDFW continues to classify wolves as endangered throughout Washington. Wolves were rarely observed in Washington through 1988, but lone wolves or small groups were documented in the Cascades in the 1990s (Wiles et al. 2011).

Since data were first collected in 2008, the state's wolf population has grown an average of 28 percent per year (WDFW et al. 2019). On March 15, 2019, USFWS published a proposal to federally delist gray wolves in the lower 48 states. Under the proposal, wolves in Washington outside of tribal lands would then be managed by WDFW (84 FR 9648).

Scat, tracks, and photographs were used to document two wolves at Hozomeen Campground along Ross Lake (near the U.S.-Canada border) in the winter of 2010/2011. Tracks of three wolves together were observed in the Hozomeen area in the spring of 2012. These wolves were suspected to be part of a pack that denned in British Columbia. Wolf tracks have been observed by NPS and City Light biologists in the drawdown zone of Ross Lake (Tressler 2019).

Most recently, in 2016 wolves were documented west of the Cascades in 2016 in Skagit County. A wolf that was captured in Skagit County and fitted with a radio-collar in 2017 was found to be travelling with another wolf in late 2018 and was named by WDFW the "Diobsud Creek" pack. This Diobsud Creek pack, which has been using the western region of the national park, is the first confirmed wolf pack west of the Cascade crest (WDFW et al. 2019). About half of the activity area for this pack noted by WDFW is within the North Cascades National Park Complex; the remainder extends to the west. The Diobsud Creek pack activity area includes portions of the transmission line corridor and fish and wildlife mitigation lands in the vicinity of the Sauk and Skagit River confluence.

Fisher

USFWS published a proposed rule to list the West Coast DPS of fisher (*Pekania pennant*) as threatened on October 7, 2014 (79 FR 60419). Prior to the proposed rule, USFWS published a 12-month finding in the FR on April 8, 2004, stating that listing the West Coast DPS of the fisher under the ESA was warranted, but precluded by other higher priority listing actions (69 FR 18770). USFWS has annually reviewed this finding and monitored the status of the fisher. On January 31, 2019, USFWS reopened the 2014 proposed rule for listing the fisher as threatened for further comment for 30 days. USFWS has not taken further action on the listing proposal. The fisher was considered extirpated from Washington state by the mid-1980s—primarily from over-trapping, habitat loss and fragmentation, and incidental mortality—and is state listed as endangered. In 2010, the WDFW began a reintroduction program, with the first release sites on the Olympic Peninsula.

The fisher is a medium-sized carnivore (7.5-12 lbs.) that preys primarily on squirrels, mice, snowshoe hares, and birds. Fishers also are one of the few predators of porcupine. Carrion and some plant material may also be consumed. The species is associated with low- to mid-elevation coniferous and mixed conifer-hardwood forests with abundant wood structure, and is found in habitats up to approximately 8,500 feet in elevation (Buskirk and Powell 1994).

A part of WDFW's fisher reintroduction project for the Cascade Mountain Range (Lewis 2013), NPS and WDFW released six fishers (one male, five females) in December 2018, in the RLNRA. Additional fishers were released in the Sauk River watershed in 2018 and 2019. The fishers were captured in Alberta, Canada as part of a multi-year effort to reintroduce up to 80 fishers into the Northwestern Reintroduction Area of the North Cascades Recovery Area. This Reintroduction Area extends from SR 2 to the Big Beaver Valley in the Park. NPS continues to participate in monitoring efforts.

4.7.2.2 Federally Designated Critical Habitat

USFWS designated critical habitat for the marbled murrelet in 1996 (61 FR 26255) and finalized the recovery plan in 1997 (USFWS 1997). The Project vicinity does not contain any designated critical habitat for marbled murrelet. Critical habitat is mapped approximately one mile south of the Bacon Creek confluence with the Skagit River and the Illabot Creek fish and wildlife mitigation land property (USFWS 2019a).

USFWS designated critical habitat for the northern spotted owl in 1992 and revised in 2008 (73 FR 47325) and again in 2012 (77 FR 71876). The East Cascades North, Subunit ECN-1 includes land in Whatcom and Okanogan counties on the Okanogan-Wenatchee National Forest. This unit is two miles east of the Ruby Arm of Ross Lake. The Northwest Washington Cascades Unit of critical habitat consists of approximately 393,500 acres in Whatcom, Skagit, Snohomish, King, and Kittitas counties, and is comprised of lands managed by the Mt. Baker-Snoqualmie and Wenatchee National Forests. This unit includes one area with approximately 18,200 acres of currently suitable habitat or habitat-capable (potentially suitable) in the adjacent Wilderness Areas and the North Cascades National Park Complex. Critical habitat is mapped approximately 0.4 mile south of City Light's Illabot Creek fish and wildlife mitigation land parcel and adjacent to City Light's Finney Creek fish and wildlife mitigation land parcel (USFWS 2019b).

There is no designated critical habitat for Oregon spotted frog, grizzly bear, gray wolf, Canada lynx, or fisher within the Project vicinity.

4.7.2.3 Other RTE Wildlife Species

The following narrative describes the occurrence of RTE wildlife species without federal protection under the ESA and their occurrence within the Project vicinity.

Western Toad

Western toads are terrestrial and may be found far from water. Breeding occurs in ponds or the shallow fringes of larger lakes. Eggs hatch in 3-12 days, and tadpoles form large schools in shallow water. After undergoing metamorphosis in one to three months, the tiny toads may aggregate before dispersing (Jones et al. 2005). The species has been documented within the North Cascades National Park Complex during stream-type amphibian surveys (Rawhouser et al. 2009). This report does not provide locations of western toad captures as this species was incidental to the focus of the study. Anecdotal evidence suggests that toads may breed in isolated ponds within the drawdown zone of Ross Lake and in wetlands along the river downriver of Newhalem (Tressler 2019).

Columbia Spotted Frog

Columbia spotted frogs (*Rana luteiventris*) are highly aquatic and associated with lakes, permanent ponds, or slow-moving streams. They occur in riparian areas where standing water is persistent. Most spotted frogs over-winter, often in spring-fed ponds. Eggs are laid from early April to early June usually in shallow, vegetated areas at the water surface in large, globular masses of 200-500 eggs laid communally in piles or clusters. Habitat loss and the introduction of non-native predators have contributed to their decline (USFWS 2009).

The Columbia spotted frog has been documented in the Big Beaver Valley, west of Ross Lake as incidental captures during invertebrate surveys (Rawhouser et al. 2009). In addition, amphibian inventory surveys of ponds and lakes in the North Cascades National Park Complex from 1996-1998 included observations of Columbia spotted frog. Frog tissue samples collected by NPS from Big Beaver Valley in 1997 were confirmed to be Columbia spotted frog by genetic testing (Holmes and Glesne 2000). In April 2011, City Light biologists observed several egg masses and one adult consistent with *Rana* spp. in open water pockets within the emergent wetland at the north end of Ross Lake in Canada. In addition, this species has been documented just north of the U.S.-Canada border along the Skagit River in Skagit Valley Provincial Park (Ovaska et al. 2019). These sites are about two miles from the northern end of Ross Lake.

Bald Eagle

Delisted from the ESA in 2007, bald eagles remain protected under the federal Bald and Golden Eagle Protection Act. Bald eagle use of the Skagit River downstream of the Project in winter is correlated with returning Chum Salmon. Weekly counts in the upper river (Newhalem Bridge to Sauk River confluence) averaged 180, and averaged 93 eagles in the lower reach (Sauk River confluence to Sedro-Woolley) over a 30-year period (Rubenstein et al. 2018). Several bald eagle communal winter roosts were documented in the Illabot Creek and Bacon Creek vicinities during the studies conducted in the 1980s. The Illabot wildlife lands encompasses part of the communal roost area.

Two eagle nests within the Project Boundary and adjacent to the Ross Lake shoreline have been active between 2015 and 2018, one at Lower Beaver Creek and one at Dry Creek (North Cascades National Park Complex 2019). According to WDFW PHS data, ten historical bald eagle nest sites occur within 0.5 mile of the transmission line portion of the Project Boundary between the Suiattle-Sauk River confluence and the Bothell Substation. Two other bald eagle nest sites occur near wildlife mitigation lands along the Sauk River. WDFW data indicates the historical use of multiple nests along the Skagit River downstream of Marblemount. The closest downstream eagle nest to the Project active in recent years is about one mile upstream of Rockport between SR 20 and the Skagit River.

Peregrine Falcon

The peregrine falcon was formerly listed as threatened under the ESA but delisted in 1999. There are three known peregrine falcon eyries between Diablo Dam and the Gorge Powerhouse within the Project Boundary, including one across the Skagit River from the Gorge Powerhouse. This site is on a cliff 550 feet from, and within line-of-sight of, the portal area. Three additional eyries are located along the Ross Lake shoreline – two on the west shore and one on the east shore. All of these eyries are within the Project Boundary.

Source: J. Kerschner

Figure 4.7-2. Peregrine Falcon perched on Gorge Dam, 2014.

Common Loon

Loons typically breed on forest lakes with deep inlets or bays with ample forage species. Lake size can range from 19 to 7,800 acres; breeding lakes are typically between 200 and 2,800 feet in elevation in western Washington. In eastern Washington, nest sites have been found at elevations up to 3,800 feet (Richardson et al. 2000). Common loons primarily eat fish but also prey on other aquatic animals (McIntyre and Barr 1997). Between 1979 and 2000, only 20 nests were documented as active in Washington State. Following the breeding season, loons migrate to marine waters where they spend the winter. Disturbance by recreationists and ingestion of discarded fishing gear are potential threats (Richardson et al. 2000).

Loons have been observed on Ross Lake throughout the spring and summer (Ransom 2019); they are also observed occasionally on Diablo Lake (McShane 2019). The species does not breed along the reservoir but appears to use it for foraging. The large reservoir fluctuation levels likely discourage nesting by loons, which typically nest within five feet of water (Richardson et al. 2000). North Cascades National Park Complex monitoring indicates that a pair of loons has successfully fledged young from sites at Hozomeen Lake (Christophersen 2016), which is about 1.4 miles east of Ross Lake outside of the Project Boundary. There is one documented record of a successful loon nest at Diablo Lake from 1971 (Richardson et al. 2000). Potential disturbance by recreation users is noted as a threat to the documented Hozomeen Lake loons (Richardson et al. 2000). In 1971 a dead adult loon was found entangled in fishing line at Hozomeen Lake (Richardson et al. 2000). Limited data on loon use of the North Cascade National Park Complex preclude inferences on population size and distribution (Hoffman et al. 2015).

Harlequin Duck

Harlequin ducks nest near fast-flowing water with loafing sites nearby. In Washington, they breed in the Olympic Mountains, the Cascades, and the Blue and Selkirk Mountains. These birds winter along the coast, northern Hood Canal, and the Strait of Juan de Fuca. They prefer streams with cobble/boulder substrate and vegetated banks. While they appear to avoid some types of human disturbances, anecdotal evidence suggests some level of tolerance of human presence (Cassirer and Groves 1994). They typically nest on the ground but also nest in tree cavities. Broods remain in the nest area for several weeks and then move downstream during the summer.

WDFW data indicate the presence of harlequin duck in tributaries to the Skagit River outside of the North Cascades National Park Complex, and surveys in the park have documented its presence (Hoffman et al. 2015). Surveys for riverine bird species in the park between 1997 and 2002 documented breeding harlequin ducks and their young on Baker River, Newhalem Creek, Chilliwack River, Big Beaver Creek, Little Beaver Creek, Thunder Creek, and the Stehekin River (Hoffman et al. 2015). Population numbers in the Project vicinity are unknown and occurrence within the Project Boundary has not been documented. Because of their secretive nature and sensitivity to human disturbance, obtaining population estimates is difficult. NPS notes that there are less than 10 observations of harlequin duck posted on eBird in the park (Hoffman et al. 2015).

Northern Goshawk

Northern goshawk is an accipiter that uses a range of habitats, but nest sites are consistently correlated with mature forests. In Washington, occupied historical nest sites tend to have a high proportion of late seral stage forest (>70 percent canopy closure of conifer species with >10 percent of the canopy trees >53 cm dbh) (Finn et al. 2002). Because goshawks hunt in the sub-canopy space of forests, mid-aged mature and old-growth forests with more open understory provide suitable structure for goshawks to pursue and capture prey (Reynolds et al. 1992).

Douglas squirrel, grouse, and snowshoe hare were the most frequently represented prey item for goshawks in both eastern and western Washington (Watson et al. 1998). Goshawk was not observed in NPS landbird monitoring surveys in the North Cascade National Park Complex during 2016 (Holmgren et al. 2017). However, several recent goshawk sightings within the Project Boundary and general Project vicinity are noted on eBird (eBird 2019).

In 2014 a juvenile goshawk flew into a window of the Diablo Powerhouse and died. Species identification was confirmed with NPS and WDFW. Goshawk nesting activity had been suspected in the general vicinity of the Sourdough Trailhead in previous years but never confirmed. Following this incident, City Light conducted protocol goshawk surveys along the lower portions of the Stetattle Creek Trail and Sourdough Trail in 2015 for evidence of nesting goshawk, but no goshawks were detected (Tressler 2019).

Townsend's Big-Eared Bat

Townsend's big-eared bat (*Corynorhinus townsendii*) was not detected or captured during wide ranging surveys in the North Cascades National Park Complex, but it has been detected nearby and there was a documented observation of one in an old cabin within the RLNRA (Christophersen and Kuntz 2003). This species roosts in man-made structures (buildings, bridges, and mines) and in natural caves. Townsend's big-eared bats are extremely sensitive to disturbance while roosting because they hang directly from the ceiling and do not go into torpor during the day in summer colonies (Barbour and Davis 1969).

Little Brown Myotis

Little brown myotis (*Myotis lucifugus*) was one of the two most abundant bat species found within the North Cascade National Park Complex during surveys conducted by NPS in 1998-2001

(Christophersen and Kuntz 2003). The little brown myotis is well adapted to humans, often taking residence in attics, bridges, and mines. Maternity colonies have been found in older buildings in the Diablo townsite and other City Light and NPS facilities. The species is a generalist that uses a range of habitats but is most common in conifer and hardwood forests. Within these habitats, riparian and open water areas are preferred. Day roosts include buildings and other structures, caves, mines, tree cavities, and beneath tree bark. Nursery colonies can contain more than 1,000 bats (Hayes and Wiles 2013). Limited acoustic bat surveys on the fish and wildlife mitigation lands documented several bat species, including little brown myotis, foraging in the forested wetlands on the City Light Barnaby Slough property during April – July (City Light 2013).

The maternity colony of mostly *M. yumanensis* at Hozomeen may also include other *Myotis* species, including the little brown. There has been historical use of houses by *Myotis* spp. in Newhalem and Diablo. The bat boxes in the townsites and the bat-condo at Hozomeen appear to be getting good use by *Myotis* spp.

Wolverine

Wolverine is one of the rarest mammals in North America and least known carnivores. The wolverine is the largest member of the mustelid family, with males weighing up to 44 lbs. (Copeland and Whitman 2003). They are wide-ranging, inhabit remote areas near timberline, give birth to young during winter in subnivean dens, and may be sensitive to human disturbance at natal and maternal dens (Copeland 1996; Copeland et al. 2007; Squires et al. 2007).

The Cascade Range in Washington is the southernmost extent of the current wolverine range along the Pacific coast (Aubry et al. 2007), but the species is more widely distributed in Washington than once thought (Aubry et al. 2014). Wolverines have recently been documented in the Teanaway Valley and east of Mt. Rainier National Park. In 2018, a wolverine was photographed near Fall City, Washington and was thought to be the same one killed crossing I-90 near Bandera in June 2018. Further south, wolverines have recently been documented near Mt. Adams and the Wallowa Mountains of northeastern Oregon.

Remote camera surveys throughout the North Cascades National Park Complex in 2005 and 2006 did not capture images of wolverine, but incidental observations indicated their presence in the Project Boundary (Christophersen 2006). During 2012 surveys, a successful reproductive den site was found in the park with a second just northeast of the park (Aubry et al. 2012). The NPS also documented a wolverine west of the Park near Sauk Mountain later in summer 2012 (NPS unpublished data).

In the spring of 2019, a wolverine was filmed foraging on an elk (*Cervus elaphus*) carcass along the east shore of Ross Lake by City Light contractors conducting snow surveys by helicopter (Tressler 2019). Recent radiotelemetry studies of wolverine in the North Cascades Ecosystem indicate that several individuals use the Project vicinity, particularly the mountainous areas around Ross Lake, as part of their documented home range.

Mountain Goat

Mountain goats are agile and are typically found on cliffs and crags within the Project vicinity, but habitat use can range between 1,200 and 7,300 feet. Recent work in the North Cascades indicates that males had a maximum home range of 10 sq. mi. and females up to 7 sq. mi. The largest types of movement were associated with a response to winter weather and occasional excursions from seasonal range (Rice 2005). In winter, goats are occasionally observed on the cliffs on the north side of SR 20 in Newhalem and within the Project Boundary. The species also is observed on cliffs along the east side of Ross Lake when winter/early spring snow depth pushes them down to lower elevations. In summer, they disperse to higher elevations and remote areas of the park.

4.7.3 USFS Management Indicator Species

The Mt. Baker-Snoqualmie District of the USFS uses Management Indicator Species (MIS) as representatives of groups of species that rely on similar habitats, as identified in the Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan (LRMP) (USFS 1990). MIS that are known to occur in or near the Project Boundary are listed in Table 4.7-4.

Table 4.7-4. Mt. Baker-Snoqualmie National Forest MIS that occur within or near the Project Boundary.

Species	Habitat
Northern spotted owl (*Strix occidentalis*)	Mature old-growth forests (nesting and roosting); second-growth forest (dispersal).
Bald eagle (*Haliaeetus leucocephalus*)	Roost, nest, and forage near lakes and large rivers.
Pileated woodpecker *(Dryocopus pileatus)*	Old-growth and mature forests.
Downy woodpecker (*Dryobates pubescens*)	Primary cavity excavators; variety of forest types.
Hairy woodpecker *(Leuconotopicus villosus)*	Primary cavity excavators; variety of forest types.
Grizzly bear (*Ursus arctos*)	Forests, meadows, sub-alpine, and alpine.
Gray wolf (*Canis lupus*)	Forests, meadows, sub-alpine, and alpine where ungulate prey is available.
Mountain goat (*Oreamnos americanus*)	Cliff and alpine habitat.
American pine marten *(Martes americana)*	Mature and old-growth forests where downed logs are available; silver fir zone.

Source: USFS 1990.

All of these species except the pilated woodpecker, cavity nesters, and American pine marten have been described in previous section.

Pileated woodpeckers *(Dryocopus pileatus)* are the largest woodpecker in North America and are relatively common in mature and old-growth forests from Puget Sound into the Cascade Mountains, preferring trees larger than 20-inch dbh (WDFW 2003). Downy (*Dryobates pubescens*) and hairy woodpeckers (*Leuconotopicus villosus*) are additional cavity excavators found within the Project Boundary. All three species have been noted incidentally by City Light biologists in the Project vicinity (McShane 2019). Nest cavities excavated by these woodpeckers are critical to other species such as swallows, bluebirds, chipmunks, and bats. Brown (1985) lists 46 species as secondary cavity users.

Pine marten is often considered an inhabitant of old-growth forests, but studies indicate that it is quite adaptable (Soutiere 1978, as cited in Strickland et al. 1982). The species dens in hollow trees or underground in rock piles, hollow logs, or tree roots. It forages on a range of items including small mammals, birds, insects, and fruits (Strickland et al. 1982). Carnivore studies in North Cascades National Park Complex indicate that it is fairly common and was recorded at 64 percent of study sites (Christophersen et al. 2005).

4.7.4 WDFW Priority Habitats and Species

WDFW provides information on important fish, wildlife, and habitats for use by local governments, state and federal agencies, and private landowners for planning purposes and education. Priority species are those that require protective measures and/or use of management guidelines to ensure their longevity. Most priority species have federal and/or Washington State status; others are commercially or culturally important. Priority habitats are those with unique or significant value to many species, have comparatively high fish and wildlife density or diversity, are important for breeding or seasonal uses, serve as migration corridors, are scarce, or are highly vulnerable to disturbance from human activity (WDFW 2019a).

WDFW PHS data (WDFW 2019a) indicate the occurrence of 13 priority species and several priority habitats in Snohomish, Whatcom, and Skagit counties (Table 4.7-5).

Priority habitats in the Project vicinity include palustrine forest and scrub-shrub wetlands, and wide areas of elk habitat west of the generation facilities that encompass some of the fish and wildlife mitigation lands and transmission line corridor. Other priority habitats that occur within the Project vicinity include Biodiversity Areas and Corridors in the suburban/developed areas of the transmission line, waterfowl concentrations, and general habitat for elk and black-tailed deer. Most of the wildlife species are described in previous sections above; those that have not been are addressed below.

Table 4.7-5. Priority species occurrence in Snohomish, Skagit, and Whatcom counties.

Species Group	Species [1]
Amphibians and Reptiles	**Columbia spotted frog**, Oregon spotted frog, **western toad**, western pond turtle (*Actinemys marmorata)*
Birds	American white pelican (*Pelecanus erythrorhynchos)*, **common loon, marbled murrelet**, western grebe (*Aechmorphorus occidentalis*), **great blue heron**, western high Artic brant (*Branta bernicla*), **wood duck (***Aix sponsa***)**, **hooded merganser** (*Lophodytes cucullatus*) Non-breeding concentrations of Barrow's golden eye (*Bucephala islandica*), common golden eye (*B. clangula*), **bufflehead** (*B. albeola*), **harlequin duck**, snow goose (*Anser caerulescens*), **trumpeter swan** (*Cygnus buccinators*), tundra swan (*C. columbianus*) **Golden eagle, northern goshawk, ban-tailed pigeon (***Patagioenas fasciata***)**, yellow-billed cuckoo (*Coccyzus americanus*), **northern spotted owl, Vaux's swift (***Chaetura vauxi***)**, black-backed woodpecker (*Picoides arcticus*), Oregon vesper sparrow (*Pooecetes gramineus affnis*)
Mammals	Roosting concentrations of **big-brown bat, Myotis bats**, pallid bat (*Antrozous pallidus*), Townsend's big-eared bat, Keen's myotis Cascade red fox (*Vulpes vulpes canadensis*), fisher, grizzly bear, **gray wolf, Canada lynx, marten, wolverine, Columbia black-tailed deer, moose**
Butterflies	Johnson's hairstreak (*Callophrys johnsoni*) and valley silverspot (*Speyeria zerene bremnerii*)

Source: WDFW 2019a; Tressler 2019.

1 Species names in bold are documented within the Project Boundary.

Yuma myotis and little brown myotis are similar in appearance and size, which can make identification difficult. Yuma myotis is widely distributed in Washington and records exist for most counties (Hayes and Wiles 2013). Population trends for the species are unknown, but it is common in both the state (Dalquest 1948) and in the Project vicinity (Christophersen and Kuntz 2003). Roosting concentrations of big-brown bat (*Eptesicus fuscus*), *Myotis* species, and pallid bat (*Antrozous pallidus*) are considered priority species or concentrations of species.

4.7.5 Wildlife Species with Special Significance

4.7.5.1 Golden Eagle

In Washington, golden eagles nest throughout much of the state but are most common in the north-central highlands transitional area between montane and shrub-steppe landscapes. Its occurrence west of the Cascade crest is considered uncommon (Larrison and Sonneberg 1968), yet up to 86 golden eagle breeding territories have been recorded in western Washington (WDFW 2013).

Golden eagles likely have been present in small numbers for centuries in western Washington where fire provided open space. Thomas (1977, as cited in Bruce et al. 1982) and Servheen (1978, as cited in Hansen 2017) indicate that forest clearcuts create favorable foraging areas for golden eagles in western Washington. One study indicated that all observed western Washington golden eagle nests were within 1,500 feet of large clearcuts or open fields, which support populations of medium-sized mammals such as mountain beaver (*Aplodontia rufa*), snowshoe hare (*Lepus americanus*), and European rabbit (*Oryctolagus cuniculus*). Servheen (1978, as cited in Hansen 2017) noted that mountain beaver made up a substantial portion of golden eagle prey in western Washington.

North Cascades National Park Complex data indicate 55 incidental observations of golden eagles west of the Cascade crest within the park ranging from the summit of Sourdough Mountain to along Ross Lake (NPS 2019c). According to WDFW PHS data, multiple historical golden eagle nest sites have been documented in the Baker River watershed but none have been documented in the Project vicinity. One nest site, last documented in 2013, is approximately 8 miles from the nearest wildlife mitigation parcel and 10 miles from the transmission line, while another nest site, reported in 2000, is more than three miles east of the South Fork Nooksack wildlife lands. There is also a suspected golden eagle nest site in the upper elevations of the Cascade River watershed more than five miles from the transmission line and fish and wildlife lands. Hansen (2017) concluded that golden eagles nesting in western Washington prefer areas at higher elevations and areas that contain less forest. These open areas are important for foraging.

4.7.5.2 Ungulates

The three ungulates that occur in the Project vicinity (black-tailed deer, elk, and moose) are particularly important species for local Native American tribes and recreational hunters and for general wildlife viewing.

- Black-tailed Deer – Black-tailed deer are the most commonly observed large mammal in the Project vicinity. Black-tailed deer populations in western Washington are stable, but habitat loss at lower elevations due to development is a continuing concern (Mule Deer Working Group 2017). Severe winter conditions during the 2016-2017 season likely affected over-winter survival of fawns to a greater degree than the previous 5 years (Mule Deer Working Group 2017). Black-tailed deer and mule deer are the same species, but those occurring east of the Cascade crest are a separate subspecies referred to as mule deer, whereas those west of the crest are referred to as black-tailed deer.

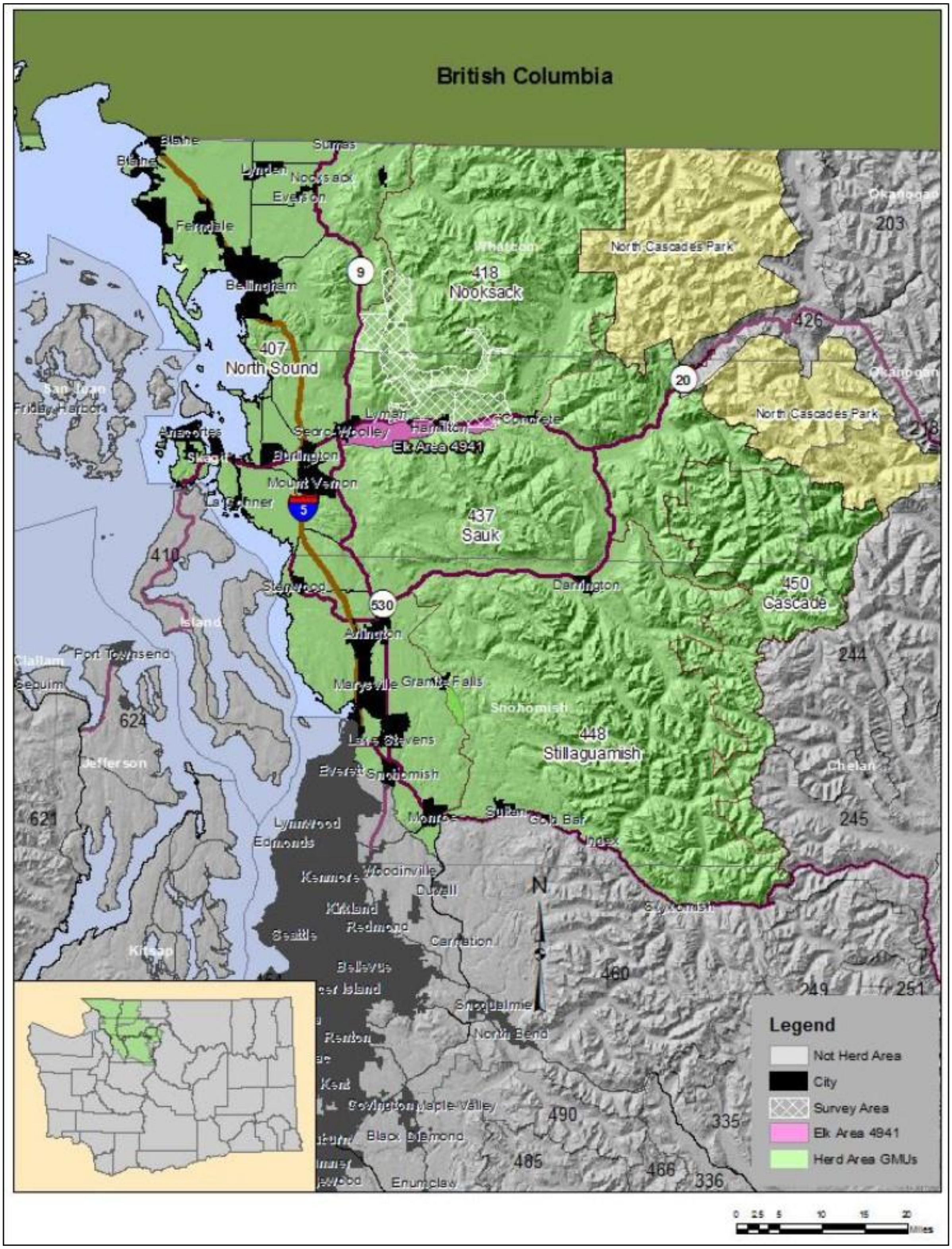
  Black-tailed deer are regularly observed in the Project vicinity, especially in the townsites and the along the transmission line ROW, but less so in the upper elevations of the North Cascades National Park Complex. Black-tailed deer inhabit higher elevations in the summer (above 2,200 feet) and use lower elevation habitat in the winter. Riparian areas are particularly important for secure fawning (Mackie et al. 1982). WDFW Game Management Units (GMU) 418 (Nooksack – west of the North Cascades National Park Complex) and 426 (the RLNRA) are the units closest to and within the North Cascades National Park Complex. In 2018, 25 permits were allotted within GMU 418, and 11 deer were harvested. Within GMU 426, 10 permits were allotted, and three deer were harvested in 2018 (WDFW 2019b).

- Moose – Moose began colonizing northeast Washington in the early 20th century and have experienced a gradual expansion in both range and population over the past century. WDFW began allowing hunting for moose in 1977. Since then, the populations have expanded along with public interest in the species for wildlife viewing and hunting. Recent surveys indicate a growing population of moose in Okanogan County with documented residence west to the Cascade crest in the North Cascade National Park Complex and further west. Quantitative data on moose populations in and around the park are not yet available (Harris et al. 2015). Moose are occasionally reported in the Project vicinity by City Light employees.

  WDFW expects that moose populations will either level off soon or start to decline due to: (1) continued expansion of wolf packs in the state; (2) changes in forest practices that are moving forests into older age-classes that provide less forage; and (3) similar declines in other states that are poorly understood but may be related to diseases, parasites, and in combination with climate change (Harris et al. 2015).

- Elk – The North Cascades elk herd, often referred to as the Nooksack Herd, is the smallest of ten herds formally recognized and managed by WDFW. Despite its relatively small size, the herd is an important recreational, aesthetic, and economic feature to Washington’s citizens, including Native American people of the area who value it as a significant cultural, subsistence, and ceremonial resource. Annual surveys indicate that the current population within GMU 418 (Nooksack) and that portion of GMU 437 (Sauk) north of the Skagit River between Lyman and Concrete (Figure 4.7-3) is about 1,046 animals (WDFW 2018). Observations from biologists and anecdotal information suggest that an additional 200–400 elk occur elsewhere in adjacent areas, primarily south of the Skagit River between Sedro-Woolley and Marblemount, with scattered individuals in the Sauk River Valley south of Rockport (WDFW 2018).

  Elk make substantial year-round use of fish and wildlife mitigation lands such as the McLeod Slough, Savage Slough, Johnson, and South Fork Nooksack parcels, and are occasionally seen on Illabot and Barnaby Slough (Figure 4.7-4) (Tressler 2019). Tracking of radio-collared elk by WDFW, the tribes, and WSDOT indicate that most elk do not make long-distance migrations but rather maintain relatively small home ranges often closely associated with the river, riparian, agricultural, and forested habitats throughout the year (WDFW 2018). There are exceptions, such as the one radio-collared elk that moved from the Baker River watershed to the area near the Newhalem Ponds and back in a one-week period. Elk regularly cross SR 20 but are rarely seen west of Sedro-Woolley. Elk-human conflicts have significantly increased since 2006 and include forage and trampling of horticultural crops, damage to gardens, and damaging fences (WDFW 2018). Cougar and wolves are the main predators of elk in the Project vicinity.



Source: WDFW 2018.

Figure 4.7-3. WDFW Game Management Units for the North Cascades elk herd.

Figure 4.7-4. Elk on Savage Slough wildlife lands, 2012.

The current North Cascades Elk Herd Management Plan (WDFW 2018) has a population objective for the North Cascades elk herd of 1,700-2,000. The population objective includes the elk within Skagit River Valley, the Acme Valley, and areas where WDFW's intent is to minimize elk/human conflicts and ensure public safety. Other objectives of the plan are as follows:

- Implement a monitoring strategy that will provide a sound basis for herd size estimation using acceptable, cost-effective methodologies.
- Increase the geographical area available for hunting on public and private lands by at least 100 sq. mi. by 2021.
- Minimize public safety risk by reducing the average annual number of elk-vehicle collisions along the SR 20 corridor between Sedro-Woolley and Marblemount by 50 percent over the next five years.
- While attempting to achieve the population objective, reduce the number of elk caused damage complaints on private lands in the North Cascades elk herd area over the next five years.
- Annually cooperate and collaborate with the tribes to implement the North Cascades Elk Herd Plan and to coordinate season setting and herd management in traditional hunting areas.

4.7.5.3 Cougar

Cougars are common to the Project Boundary and their movements are highly tied to their primary prey item, mule deer (Dixon 1982). In Washington, elk comprised 9 percent of cougar's diet while a study in Oregon indicated elk was 11 percent of cougar's diet (Schwartz and Mitchell 1945; Toweill and Meslow 1977). A study in northeastern Washington indicated 60 percent of cougar kills were white-tailed deer and 40 percent were mule deer (Cruickshank 2014).

Territory size in Washington averages 134 sq. mi. for males and 77 sq. mi. for females (Kertson et al. 2013; Maletzke et al. 2014). Males strongly defend territories against other males, but often overlap with female territories. Because of this behavior, male territories are arranged on the landscape like puzzle pieces with low overlap. Since 1996 the use of dogs for cougar hunting has been banned except during periodic management removals to address recurring cougar conflicts with livestock and pets (WDFW 2015).

The RLNRA is located in GMU 426 and the area west of the North Cascades National Park Complex to Sedro-Woolley, north to the U.S.-Canada border and south to Darrington encompass GMUs 418 and 437. The cougar population for these three GMUs, excluding kittens, is an estimated 91 individuals with an annual harvest guideline of 11-17 animals (WDFW 2015). Data are not provided by GMU. Cougar density and distribution within the RLNRA is not known, but NPS notes that the species has a wide distribution within the North Cascades National Park Complex and has been regularly observed at lower elevations near park roads and trails (Holmgren et al. 2015). City Light and NCI staff also occasionally observe cougar within the Project Boundary, including in and near the townsites and generation facilities.

4.7.5.4 Black Bear

Black bears are a common carnivore found in the Project Boundary and are very adaptable in their habitat requirements. Throughout its range prime black bear habitat is characterized by relatively inaccessible terrain, thick understory vegetation, and abundant sources of food in the form of shrub or tree-born soft or hard mast. Winter dormancy is an important feature of black bear ecology and energy conservation. Bears consume primarily grasses and forbs in the spring, fruits throughout the summer, and a mixture of hard and soft mast in the fall. A small proportion of their diet consists of animal matter (Pelton 2000).

An average of 525 human-bear interactions are documented annually in Washington, but bear activity varies with environmental conditions. In 2010, for example, human-bear complaints reached an all-time high as Washington experienced a late spring and poor forage conditions for black bear followed by a poor fall blueberry crop (WDFW 2015). Bears often seek sapwood as a preferred food source when emerging from dens after winter. Trees with high growth rates have the highest sugar content and this can lead bears to damage commercial forest stands (WDFW 2015). WDFW manages bear as a game animal for each GMU within the state. The RLNRA is included in GMU 426 where two bears were harvested in 2018 (WDFW 2019b).

A North Cascades National Park Complex forest carnivore study using remote camera traps indicated that black bear was the most frequently detected carnivore species and was detected at 82 percent of the study sites. Bear detection sites ranged from 2,600-4,363 feet in elevation (Christophersen 2006).

A landscape genetics study completed by Long et al. (2013) for the North Cascades Ecosystem (south of I-90 to the U.S.- Canada border) found that black bear gene flow was most affected by bears avoiding moving across higher elevation (nearly one mile), rugged terrain. The study suggested the importance of maintaining connectivity among lower elevation, high-quality, forested habitats for black bears.

Black bears are common visitors to Diablo, Newhalem, and the ELC and are often seen along roads and the reservoir shorelines. WDFW has removed problem bears from these areas a few times over the years. City Light provides residents of Newhalem and Diablo and contractors working at the Project with education on how to avoid attracting bears and what to do if a bear is encountered. As of 2019 all occupied houses in the towns and other buildings have bear-proof trash cans (McShane 2019).

4.7.5.5 Beaver

Beavers are common along the Skagit River below the dams, including at several of the fish and wildlife mitigation parcels, but comprehensive data on distribution and abundance within the Project Boundary in the RLNRA is lacking. Beavers are known to occur in the upstream end of Gorge Lake, especially near Reflector Bar (McShane 2019). Downstream of Gorge Powerhouse there are several constructed Chum Salmon spawning channels where beavers have been attempting to construct dams. The Upper Skagit Indian Tribe has worked with WDFW to remove these dams and use lethal means to control the problem beavers and maintain the function of these spawning channels. Until recently it was illegal to trap beavers and move them to another location in western Washington but the state law was changed (RCW 77.32.585), allowing for additional flexibility regarding beaver translocation. The Upper Skagit Indian Tribe is interested in potentially using sites upstream of the Project to release trapped problem beavers from downstream of the Project.

4.7.6 Known or Potential Effects

4.7.6.1 Project-Related Effects

Potential Project-related effects on wildlife include the following:

- **Effects of Reservoir Operations –** Reservoir water level fluctuations may affect pond-breeding amphibians in the Project reservoirs where at least two species are known to use fringing emergent habitat, seasonal isolated pockets of open water, and segments of low-gradient streams. The degree to which water level fluctuations affect amphibians through modified habitat is unknown. It is currently unknown whether the federally-listed Oregon spotted frog or the state-listed Columbia spotted frog occur along Project reservoirs.
- **Effects of Invasive Plant Species on Habitat Value –** Invasive plants can degrade the value of wildlife habitat by replacing native species, disrupting trophic interactions and altering habitat structure and function. Areas of disturbance within the Project vicinity, including recreational areas, roads, and areas of reservoir operations, are areas where invasive vegetation frequently thrives. As noted in Section 4.6.7, non-native, invasive plants (e.g. Himalayan blackberry, Scot’s broom, English ivy, and clematis, etc.) occur along some sections of the transmission line and in isolated patches on wildlife lands. Also, reed canarygrass has become established along segments of Ross Lake and is affecting plant species composition and wildlife habitat structure in some wetlands used by amphibians. This can adversely affect amphibian populations.
- **Facility Bird Collision Hazard –** According to the USFWS and conservation organizations, millions of birds die annually from collisions from manmade structures, including wind turbines, powerlines, and buildings. Unless directly observed, avian mortality from collisions with manmade structures is difficult to detect because carcasses can be hard to find and/or are quickly scavenged.

  Early in the current Project license period, a working group of biologists from WDFW, USFWS, universities, and City Light was convened to monitor the Project transmission lines and assess collision risk to bald eagles. Information from local researchers documented one dead bald eagle under the transmission lines near Corkindale Creek (between Rockport and Marblemount) between 1973 and 1995 (Springwood 2001). Subsequent monitoring of bald eagle flights near the transmission line conducted in 1996-2000 did not document any collisions during more than 230 eagle flights that crossed the lines (Springwood 2001). The working group agreed that overall, bald eagle collisions with the transmission line are likely rare events but that there will always be some risk to individual eagles, particularly during low visibility conditions or when birds are distracted, even if lines are marked.

Although there are only a few anecdotal reports, bird collisions with building windows at the Project are likely to occur. Early in the operation of the ELC, NCI staff noted multiple bird collisions with several of the windows in the facility and subsequently installed decals designed to increase the visibility of the glass. This action was reported as effectively reducing collisions (McShane 2019). The only known raptor collision mortality associated with a Project facility was a juvenile goshawk at the Diablo Powerhouse in 2014.

4.7.6.2 Cumulative Effects

Potential cumulative impacts on wildlife resulting from continued operation of the Project together with other past, present, and reasonably foreseeable future actions include the following:

- The RLNRA GMP (NPS 2012) states that the park is facing increased visitation and that changes to park facilities and management will be necessary to accommodate increases in use. Upgrades to NPS facilities to accommodate increased public demand, such as new boat launches, parking, or other visitor facilities, would increase development along the reservoirs and Skagit River. These developments, in combination with existing Project-related recreational use, may cause cumulative disturbances to wildlife.
- The RLNRA GMP also states that climate change is an increasing concern in the context of fire management. Management actions to reduce the risk of fire-related concerns, such as thinning around facilities and campgrounds, in combination with existing Project-related vegetation management, could result in cumulative effects on the quality of wildlife habitat.
- Mining on any of the many claims in or near the Project Boundary could, in combination with the effects of the Project, result in cumulative effects on botanical resources, increasing net losses of vegetation in the Project vicinity. This would have a general, corresponding effect on wildlife that use these habitats. For example, Kiewit Infrastructure Co. owns a site near Marblemount that could be developed into a large rock quarry.
- Increased recreational use of the Skagit River corridor such as guided tours, rock climbing, cycling, horseback riding, in combination with Project-related recreation, has the potential to degrade habitat and have a corresponding negative effect on wildlife that use these areas.
- Timber harvest on private lands near the Sauk River and adjacent to the Project’s transmission line will likely continue to affect wildlife habitat. Combined with Project-related vegetation management within the transmission line ROW, clearcutting and harvesting on adjacent private lands could increase the likelihood of introducing noxious weeds, thereby degrading wildlife habitat.

4.7.7 Existing or Proposed Protection, Mitigation, and Enhancement Measures

4.7.7.1 Existing Measures

Under the current Project license, City Light has developed and implemented wildlife-focused protection and enhancement measures in cooperation with NPS and a range of other LPs. These efforts are briefly described below.

Purchase and Management of Fish and Wildlife Mitigation Lands

During the current Project license period, City Light has coordinated with the signatories to the WSA to purchase lands for fish and wildlife habitat preservation in the larger Skagit River watershed. The WSA required City Light to make available $19,940,000 (1990$) for funding measures and programs in the Wildlife Plan including for the purpose of securing and preserving valuable wildlife habitat in the Skagit, Sauk, and South Fork Nooksack watersheds. Approximately $17 million was specifically set aside for land acquisition. This has resulted in the protection of approximately 10,850 acres in the Skagit, Sauk, and South Fork Nooksack watersheds. Management priorities include protection of old-growth forests, restoration of riparian and wetland habitats, creation and maintenance of elk forage areas, and removal of stream culverts and riprap from riverbanks.

City Light developed a long-term management plan, the Wildlife Mitigation Lands Management Plan (City Light 2006), to support its obligation to address the long-term protection and management of lands purchased pursuant to its FERC license for the Project. In general, management is intended to be minimal or low-intensity, and directed toward habitat acquisition and preservation. Management of these lands is done consistent with tribal rights. The plan addresses administrative and habitat-related issues and includes monitoring, public use, road management and abandonment, fire management, cultural resource protection, use of land for research, and future data acquisition and reporting. Habitat management involves protection and enhancement of the natural features of the properties.

Monitoring and Education Funds

City Light annually provides funds to NPS for long-term ecological monitoring including monitoring for rare plants, bats, migratory birds, marmots, pikas, bald eagles, peregrine falcons, loons, wolves, fishers, other forest carnivores, and harlequin ducks. City Light also renovated and maintains a building in Newhalem to serve as a wildlife research laboratory for NPS.

In support of USFS efforts to protect bald eagles in the Skagit River basin, City Light provides funds for monitoring this species. Funds are also provided for educational activities during winter bald eagle viewing events sponsored by USFS and Washington State Parks. The WSA stipulated that City Light provide $20,000 (1990$) per year to NPS over the course of the 30-year license ($600,000 total; 1990$). An additional $90,000 (total; 1990$) was provided to USFS for bald eagle monitoring along the Skagit River.

City Light also provides annual funding of $20,000 (1990$) to NCI to support wildlife education programming, primarily for Mountain School at the ELC, which is a three-day targeted environmental education program for fifth graders.

Wildlife Research Grants

City Light offers wildlife research grants to qualifying applicants on an annual basis. The primary goal of the research grant program is to facilitate the development of improved methods for understanding, managing, and protecting wildlife and their habitats in the North Cascades Ecosystem, with an emphasis on the Skagit River watershed. A secondary goal of the program is to contribute to the training of new researchers and investigators. The WSA stipulated that City Light make available $50,000 (1990$) each year for research over the 30-year license period ($1.5 million total).

Since 1995, City Light has funded more than 50 grants on a range of research projects. Research topics have included riparian plant communities, aquatic invertebrates, shorebirds in the Skagit River Delta, lynx ecology, mountain goats, American pikas, wolverines, amphibians, and grizzly bears. These grant-funded projects are directly relevant to the Skagit River watershed and have been located throughout western Washington and into southern British Columbia. City Light also provided funds ($600,000 [1990$] over the course of the license period) for the ELC on Ross Lake.

Avian Protection Measures

Under the current Project license, City Light completed the bald eagle monitoring in lieu of the Aviation Marker Plan that was originally required by the FERC in Article 411. This change was ordered by FERC on January 22, 1996. Based on the monitoring results, City Light installed Bird Flight Diverters on the Uppermost (fiber optic) line at seven transmission line segments between Rockport and Newhalem where there are known concentrations of wintering bald eagles: Corkindale Creek, Illabot Creek, Diobsud Creek, Bacon Creek, Pinky's, Shovel Spur, and Goodell Creek (Springwood 2001). The work group of biologists convened under the current license also concluded that lines on new construction should be marked in bald eagle concentration areas.

City Light also has a utility-wide Avian Protection Plan that is approved by the USFWS (http://www.seattle.gov/light/enviro/avian/) and obtains annual permits from USFWS and WDFW to manage bird electrocution, collision, and problem nest issues. Known avian mortalities are annually reported to USFWS; nest management activities and bird mortalities are annually provided to WDFW. At locations where bird mortality occurs due to electrocution or collision, City Light installs avian protection equipment to reduce future risk.

Helicopter Noise Protection Measures

City Light consults with the NPS and USFWS to determine potential noise impacts on listed species and/or wildlife species of special significance (i.e., peregrine falcons, spotted owls) if helicopter use is needed for maintenance projects outside the winter season. If possible, helicopter use for Project-related work is scheduled to avoid the breeding and rearing season for birds (April through August).

4.7.7.2 Proposed Measures

As discussed in Section 4.6.8.2 of this PAD, City Light proposes to develop comprehensive vegetation management plans for the various parts of the Project vicinity. These plans will incorporate wildlife protection BMPs In addition, City Light recognizes the need for a comprehensive update for the Wildlife Mitigation Lands Management Plan (City Light 2006) to incorporate newly acquired lands and include site-specific management activities to protect or enhance wildlife habitat conditions. This plan would be developed in collaboration with LPs. The results of relicensing studies will be used to develop other PME measures for wildlife in collaboration with LPs. City Light will develop a comprehensive Transmission Line Corridor Management Plan that includes BMPs to protect natural and cultural resources from direct and indirect impacts from Project O&M activities as well as indirect impacts due to recreational use of City Light roads and trails.

4.8 Recreation and Land Use

This section describes existing conditions pertaining to recreation facilities, opportunities, and use; and land uses within the Project Boundary and vicinity. The Skagit River Project is in a remote area, with steep terrain and harsh winter conditions that both define and limit recreation opportunities. Major population centers are 100 miles distant, and parks and the one highway in the vicinity are closed each year, usually from November until April. Nonetheless, the Project reservoirs and surrounding area provide numerous recreational opportunities and receive a significant level of visitation, especially in the summer.

The Project is unique in that the generation facilities are almost entirely within a national recreation area, the RLNRA, which was established in 1968 and is managed by the NPS as part of the North Cascades National Park Complex. Additionally, the Project is bordered on the east and west by National Forest and is upstream of the Skagit River Wild and Scenic River System. The Project Boundary also encompasses two towns, which are owned by City Light, and an environmental education center (Environmental Learning Center).

This unique setting is important to a discussion of recreation and land use in a FERC relicensing context. A great deal is already known about land and recreation resources in the Project vicinity. This PAD summarizes, discusses, and references abundant existing, available, relevant information, much of it developed by NPS as the entity responsible for recreation management in the RLNRA and surrounding park. Regionally, the USFS also provides recreational opportunities, as do various state and local agencies. Under the current Project license, City Light supports public access and recreational, educational, and interpretive facilities and services within the Project Boundary and on the surrounding federal lands. Many of these facilities and services have a history that reaches back to the Project's construction 100 years ago.

4.8.1 Existing Recreation Facilities

City Light has developed and currently operates several recreation facilities and programs at the Skagit River Project, most of which are requirements of the current Project license (FERC 1995), and described in the Recreation and Aesthetics Settlement Agreement (City Light 1991). The section that follows describes the existing recreational facilities and opportunities within the Project Boundary and vicinity, owned or managed not just by City Light, but also NPS, NCI, Ross Lake Resort, and USFS. Facilities operated and maintained by others are included in this section because these sites are either located within or near the Project Boundary, or were included in the Recreation and Aesthetics Settlement Agreement and developed, operated, or maintained with City Light funding. A map displaying all of the sites and facilities detailed in this section is appended to this PAD.

4.8.1.1 Ross Lake

The 24-mile-long Ross Lake has a largely undeveloped shoreline surrounded by scenic mountains and provides opportunities for water-based recreation, camping, and hiking. Numerous recreation facilities are available for day and overnight use. All recreation facilities on the Ross Lake shoreline in the U.S. are within the Project Boundary and the RLNRA; the northernmost approximately one mile of Ross Lake crosses the international boundary and extends into British Columbia's Skagit Valley Provincial Park.

Access to Ross Lake, especially motorized access, is limited. Motor vehicles may access the north end of the lake from Hope, British Columbia, via the 40-mile-long gravel Silver Skagit Road. There is no direct road access to Ross Lake from the south. The Diablo Lake Ferry, described in Section 4.8.1.2 of this PAD, operates from mid-June through October and makes two round trips per day between the West Ferry Landing near Diablo Dam to the East Ferry Landing about 0.25 mile downstream of Ross Powerhouse. The East Ferry Landing provides access to Ross Lake via the mile-long Ross Haul Road, which gains 520 feet in elevation from the East Ferry Landing to Ross Dam and then descends 120 feet to a Ross Lake Resort dock on Ross Lake. Alternatively, visitors may also canoe or kayak across Diablo Lake to a paddle craft dock adjacent to the East Ferry Landing. From there, visitors may portage around Ross Dam via the Ross Haul Road. Visitors may also utilize a shuttle service run by Ross Lake Resort under an NPS special use permit which provides motorized transport to visitors and their portable watercraft via the Ross Haul Road to the same Ross Lake Resort dock.

Ross Lake can also be reached by various hiking trails. These trails extend outside the Project Boundary and are maintained by NPS. The most direct route is the Ross Dam Trail, which begins at mile marker 134 on SR 20; the trail is one mile long and drops approximately 700 feet in elevation. Another trail to Ross Lake, the Panther Creek Trail, has its trailhead on SR 20 near the upper end of Ruby Arm. It is also possible to reach Ross Lake via the Diablo Lake Trail, which begins near the North Cascades ELC and runs along the north shore of Diablo Lake. The Diablo Lake Trail crosses the upper end of Diablo Lake via a suspension bridge just downstream of Ross Powerhouse and connects to the Ross Haul Road for access to Ross Lake.

Hozomeen

Hozomeen provides public access and recreation facilities at the north end of Ross Lake. There are boat launches, docks, a ranger station, campgrounds, trails, and day use areas (Figure 4.8-1). These facilities are on lands managed by NPS within the Project Boundary and are operated and maintained by NPS. Adjacent to Hozomeen on the Canadian side of the international border, within Skagit Valley Provincial Park and operated by BC Parks, Ross Lake Campground provides similar recreation facilities. In recent years, the NPS ranger station has not always been staffed, although the NPS and BC Parks have collaborated on interpretive programs on both sides of the U.S.-Canada border.

Figure 4.8-1. Hozomeen ranger station.

There are two concrete boat ramps for launching trailered watercraft at Hozomeen: Hozomeen Boat Launch, usable at reservoir elevations of 1,583 feet and higher; and Winnebago Flats Boat Launch, usable at reservoir elevations of 1,594 feet and higher. The International Point Boat Launch in Skagit Valley Provincial Park is usable at reservoir elevations of 1,600 feet and higher. These sites are the only publicly available ramps to launch trailered boats on Ross Lake.

The only camping facilities on Ross Lake accessible by road are located at Hozomeen. These include Ross Lake Campground in Canada, and Hozomeen Campground and Winnebago Flats in the U.S. The Hozomeen Campground has 75 designated sites (NPS 2019b) available on a first-come basis (Figure 4.8-2), potable water, and vault toilets. Winnebago Flats is north of Hozomeen Campground by approximately one mile, near the Winnebago Flats boat launch.

Figure 4.8-2. Hozomeen Campground.

Ross Lake Resort Visitor Dock

The Ross Lake Resort Visitor Dock is located on the east side of Ross Lake just upstream of Ross Dam. The dock is operated and maintained by Ross Lake Resort. This site is accessible from the Ross Haul Road originating from either the East Ferry Landing or Ross Dam Trail terminating at the waters' edge on Ross Lake. It is used only by portable paddle craft and by Ross Lake Resort, which picks up guests who arrive via the Ross Haul Road shuttle or on foot.

Ross Lake Resort

Ross Lake Resort is privately owned and operates under a special use permit from NPS. The resort has been in operation since 1950. The resort provides lodging accommodations in completely furnished cabins built atop a system of floating logs used historically by crews logging the area to be flooded by the reservoir (Figure 4.8-3). Ross Lake Resort is open June-October and is the only lodging facility on Ross Lake. In addition to lodging, the resort rents fishing equipment, canoes, kayaks, and motorboats, and operates a water taxi service to all major trailheads and camps along Ross Lake.

The resort is located just north of Ross Dam on the west shore of the lake. There is no direct road access to the resort. Visitors must hike or boat to the resort. The resort also provides a portage service for a fee from the East Ferry Landing to Ross Lake. In addition to visitors, the portage service will transport portable boats and camping equipment. Ross Lake Resort also provides the only motorboat fueling station for public use on Ross Lake.

Figure 4.8-3. Ross Lake Resort.

Boat Access Camps

There are 19 boat access camps on Ross Lake, 12 with floating docks, all managed and maintained by NPS (Table 4.8-1). They vary in distance from one mile (1.3 km) to 11 miles (17.6 km) from developed access points at Ross Dam or Hozomeen. Facilities available at the boat access camps include picnic tables, fire-rings, vault toilets, bear-resistant food boxes, trailheads, and docks (Figures 4.8-4 and 4.8-5; NPS 2019a). Access to the floating docks varies with Ross Lake water surface elevations. A backcountry permit is required for overnight camping at these sites.

Table 4.8-1. Ross Lake boat-in campsites.

Camps	Miles (km) from Ross Dam	Miles (km) from Hozomeen	Number of Sites	Group Sites	Trail Access	Boat Dock	Minimum lake level required to access floating dock (feet)
Green Point	0.8(1.3)	21.2 (33.9)	5	X	X	X	1,598
Cougar Island	2.4 (3.9)	19.6 (31.4)	2			X	1,594
Roland Point	3.5 (5.8)	18.5 (29.6)	1				
McMillan	4 (6.4)	18 (28.8)	3	X		X	1,596
Spencer's	4.3 (6.9)	17.7 (28.3)	2			X	1,596
Big Beaver	4.6 (7.4)	17.4 (27.8)	7	X	X	X	N/A
May Creek	5 (8)	17 (27.2)	1		X	X	1,596
Rainbow Point	6 (9.6)	16 (25.6)	3		X	X	1,590
Devil's Junction	9 (14.4)	13 (20.8)	1		X	X	1,594
Ten Mile Island	10 (16)	12 (19.2)	3				
Dry Creek	10.4 (16.7)	11.6 (18.6)	4	X			
Ponderosa	11 (17.6)	11 (17.6)	2	X			
Lodgepole	11.4 (18.4)	10.6 (17)	3	X	X		
Lightning Creek Stock Camp	11.8 (18.9)	10.2 (16.3)	2	X	X		
Lightning Creek Boat Camp	12 (19.3)	10 (16)	5	X	X	X	1,598
Cat Island	13 (20.8)	9 (14.4)	4	X		X	1,586
Little Beaver	15 (24)	7 (11.2)	5	X	X	X	1,582
Boundary Bay	16.5 (26.5)	5.5 (8.8)	3	X			
Silver Creek	20 (32)	2 (3.2)	3	X		X	1,599

Source: NPS 2019a; NPS 2019c.

Figure 4.8-4. Typical facilities provided at boat-in campsite on Ross Lake.

Figure 4.8-5. Floating dock configuration at boat-in campsite on Ross Lake.

Trails

Numerous hiking trails originate on the Ross Lake shoreline (Table 4.8-2). They connect to a network of trails allowing hikers to pursue a range of recreation opportunities in the RLNRA, North Cascades National Park, Stephen Mather Wilderness Area, and Pasayten Wilderness Area. The longest of these trails is the 31-mile East Bank Trail (Figure 4.8-6), which contours along the east shore of Ross Lake from its trailhead on the SR 20 on Ruby Arm all the way to Hozomeen near the U.S.-Canada border. The East Bank trail intersects with a number of other trails, allowing hikers to travel through the RLNRA and into the Pasayten Wilderness Area and Okanogan-Wenatchee National Forest to the east.

The Pacific Northwest Scenic Trail (PNT), a designated national scenic trail that extends from Glacier National Park in Montana to the Pacific Ocean, passes through the Project at Ross Lake. The PNT joins the East Bank Trail near the mouth of Devil’s Creek and follows the lake’s east shore to Ross Dam, where it proceeds up the west shore of Ross Lake to Big Beaver Creek.

Table 4.8-2. Representative hiking trails in the Ross Lake vicinity.

Trail	In FERC Boundary (Yes, No, Partially)	Start	End	Length (miles one-way)	Elevation gain (ft)	ADA Accessible	Difficulty
Ross Dam Trail	Partially	SR 20 Milepost 134	Ross Dam	1.0	-700	No	Easy
Happy Creek Trail	No	SR 20 Milepost 134.5	same as start	0.5	level	Yes	Easy
East Bank Trail	Partially	SR 20 Milepost 138	Hozomeen	31	rolling	No	Moderate
Panther Creek	Partially	SR 20 Milepost 138	Fourth of July Pass	6.5	2,300	No	Strenuous

Trail	In FERC Boundary (Yes, No, Partially)	Start	End	Length (miles one-way)	Elevation gain (ft)	ADA Accessible	Difficulty
Happy Panther Trail	Partially	Ross Haul Road	East Bank Trailhead on SR 20 Milepost 138	6.2	550	No	Moderate
Lightning Creek Trail	Partially	Ross Lake at Lightning Cr mouth	Deerlick campsite	4.6	475	No	Moderate
Devil's Dome Loop Trail	Partially	SR 20 Milepost 141	Ross Lake near Devil's Creek Mouth	40.4 (loop)	Approx 3,300	No	Strenuous
Desolation Peak Trail	Partially	Ross Lake at Desolation Trailhead	Desolation Peak Fire Lookout	4.8	4,400	No	Strenuous
Little Beaver Trail	Partially	Ross Lake at Little Beaver Mouth	Whatcom Pass	17.5	3,604	No	Strenuous
Big Beaver Trail	Partially	Ross Lake at Big Beaver Mouth	Beaver Pass	13.7	2,018	No	Strenuous
Pacific Northwest Scenic Trail	Partially	Ross Lake at Devil's Ridge Trailhead	Big Beaver	13.8 (inside the Project Boundary)	rolling	No	Moderate

Source: NPS 2019d; PNTA 2019; Washington Trails Association 2019.

Figure 4.8-6. East Bank Trail suspension bridge over Lightning Creek on Ross Lake.

4.8.1.2 Diablo Lake

The 4.5-mile-long Diablo Lake, with several developed recreation facilities on the shoreline and direct access from SR 20, is the most publicly accessible of the three Project reservoirs. Recreation opportunities include water sports, camping, hiking, angling, environmental education, and boat tours. Diablo Lake's brilliant turquoise waters offer a scenic view contrasted against the mountain backdrop (Figure 4.8-7). Recreation facilities and services at Diablo Lake include the ELC, boat tours and ferry service, docks and ferry landings, a boat launch, campgrounds, boat access camps, and trails. Unless otherwise stated, all recreation facilities along the Diablo Lake shoreline are within the Project Boundary and the RLNRA.

Figure 4.8-7. Diablo Lake, view from Diablo Lake Overlook.

Skagit Tour Dock

The Skagit Tour Dock is on the north shore at the west end of Diablo Lake (Figure 4.8-8). It is managed and maintained by City Light. The dock is accessible by vehicle from Diablo Dam Road. It is used exclusively for Skagit Tours which are offered by City Light during the summer months and are described further in Section 4.8.2.2 of this PAD.

Figure 4.8-8. Skagit Tour Dock.

West Ferry Landing

The West Ferry Landing is on the north shore at the west end of Diablo Lake and is managed and maintained by City Light (Figure 4.8-9). The landing is accessible by vehicle from Diablo Dam Road. It is used exclusively for embarking and disembarking the Diablo Ferry which provides boat transportation to the East Ferry Landing, and ultimately Ross Lake, via the Ross Haul Road. The ferry generally operates from June through the end of October, as described further in Section 4.8.2 of this PAD.

Figure 4.8-9. West Ferry Landing.

East Ferry Landing

The eastern terminal for the Diablo Lake Ferry is the East Ferry Landing, which is on the south shore at the east end of Diablo Lake. A canoe/kayak dock is attached to the East Ferry Landing dock, providing access for visitors who wish to shuttle non-motorized watercraft to and from Ross Lake via the Ross Haul Road. Both the ferry landing and the canoe/kayak dock are maintained by City Light (Figure 4.8-10).

Visitors may walk between the East Ferry Landing and Ross Lake via the Ross Haul Road or be transported by a shuttle operated by Ross Lake Resort, as described in Section 4.8.1.1 of this PAD.

Figure 4.8-10. East Ferry Landing with Lake Kayak/Canoe Dock on left.

North Cascades Environmental Learning Center

The ELC opened in 2005 and was awarded Silver Certification under the Leadership in Energy and Environmental Design (LEED) Green Building Rating System in 2009 (Figure 4.8-11). The ELC is located on land managed by NPS while the facilities are owned by City Light, which in turn leases them to NCI, a non-profit organization focused on environmental education. The primary purpose of the ELC is to provide in-depth environmental education, particularly to youth, but also to adults and families. NCI also hosts tours, conferences, trainings, retreats, and other special events for organizations and civic groups throughout the year. In addition to developing these various programs and experiences at the ELC, NCI is responsible for the site's day-to-day operations. NCI charges fees for participation in most programs but uses funds from private contributions to subsidize most of the environmental education programs it offers to schools.

The facility has 16 buildings including multimedia classrooms, a research library, aquatic and terrestrial labs, overnight lodging for up to 92 guests, housing for graduate students and staff, and a lakeside dining hall with recycling and composting center. There is also an outdoor amphitheater, several outdoor learning shelters, and various trails and paths. The ELC Canoe and Kayak Dock, located on the beach in front of the ELC, provides access to Diablo Lake for visitors participating in programs at the ELC and is used for boats housed at the ELC.

Figure 4.8-11. North Cascades Environmental Learning Center.

Colonial Creek Campground

Colonial Creek Campground provides the only campground on Diablo Lake accessible by motor vehicle. It is located on Thunder Arm, the largest tributary feeding Diablo Lake. Colonial Creek Campground and associated recreation facilities straddle the Project Boundary and are operated and maintained by NPS. Recreation facilities at Colonial Creek Campground include a day use area, campground, boat launch, boat dock, trailheads, and an accessible fishing pier. The Colonial Creek boat ramp provides the only public launch site for trailered boats onto Diablo Lake. The launch consists of a concrete ramp and adjacent dock (Figure 4.8-12).

Colonial Creek Campground's south loop has a total of 93 designated sites, three of which are accessible and five are designated group sites (NPS 2019b). South loop sites are available for advance reservation on www.recreation.gov. Site 115 in the south loop is a campsite held for bicyclists on a first-come basis. In addition to the features identified above, the south loop contains an information kiosk, RV dumping station, fish cleaning station, and outdoor theater for ranger programs. The north loop has 42 designated sites, one of which is accessible, and ten are designated walk-in sites. North loop sites are available on a first-come basis. Neither loop in the campground is suitable for large recreational vehicles. The campground has potable water, flush toilets, and garbage and recycling service.

Figure 4.8-12. Colonial Creek Boat Launch and Dock.

Boat Access Camps

There are three boat access camps on Diablo Lake equipped with fire-rings, picnic tables, vault toilets, and bear-resistant food storage boxes (Table 4.8-3). The camps are managed by NPS and a backcountry permit is required for overnight use of these sites.

Table 4.8-3. Diablo Lake boat-in campsites.

Boat-in Camp	Miles (km) from Colonial Creek Campground	Number of Sites	Boat Dock
Buster Brown	2.8 (4.7)	3	X
Hidden Cove	2.6 (4.3)	1	X
Thunder Point	2.0 (3.3)	3	X

Source: NPS 2019c.

Trails

Diablo Lake Trail begins near the ELC and extends to Ross Dam (Table 4.8-4). It traverses the hillside on the north shore of Diablo Lake and crosses to the south shore on the east end of Diablo Lake via a suspension bridge just below Ross Dam (Figure 4.8-13). It travels in and out of the Project Boundary.

The Thunder Creek Trail starts in the south loop of the Colonial Campground, and the Thunder Knob Trail starts in the north loop. The Thunder Creek Trail provides access to destinations and trail networks in North Cascades National Park and the Stephen Mather Wilderness Area, some of which connect to the Lake Chelan National Recreation Area. The out-and-back Thunder Knob Trail provides access to a viewpoint of Diablo Lake (Table 4.8-4). Both trails are on lands managed by NPS and are maintained by NPS.

Table 4.8-4. Hiking trails adjacent to Diablo Lake.

Trail	In FERC Boundary (Yes, No, Partially)	Start	End	Length (miles one-way)	Elevation gain (ft)	ADA Accessible	Difficulty
Diablo Lake	Partially	Environmental Learning Center	Ross Powerhouse	3.8	1,400	No	Moderate
Thunder Creek	Partially	Colonial Creek Campground, south loop	Park Creek Pass via Fourth of July Pass	19.6	4,900	No	Strenuous
Thunder Knob	Partially	Colonial Creek Campground, north loop	Thunder Knob	1.8	425	No	Moderately easy

Source: NPS 2019d.

Figure 4.8-13. Diablo Lake trail suspension bridge over Skagit River/Diablo Lake.

4.8.1.3 Diablo Townsite

Trailhead parking, trailheads, and signage for the Sourdough Mountain and Stetattle Creek Trails are located on City Light property in the Hollywood section of Diablo. These two trails extend into North Cascades National Park and are maintained by NPS (Table 4.8-5). A third trail originates in Reflector Bar and was originally constructed to provide a means of reaching Diablo Dam if other access (road and helicopter) was unavailable. Currently, this trail is used mostly by NCI staff who live in Diablo and work at the ELC. It is entirely within the Project Boundary on land managed by NPS; while not shown on RLNRA maps, it is available for public use. City Light also maintains the Ross Lodge picnic shelter for public use on City Light property within the Project Boundary (Figure 4.8-14). See Section 3.4.4 of this PAD for more details on the townsite itself.

Table 4.8-5. Hiking trails associated with Diablo townsite.

Trail	In FERC Boundary (Yes, No, Partially)	Start	End	Length (miles one-way)	Elevation gain (ft)	ADA Accessible	Difficulty
Sourdough Mountain	Partially	Diablo Hollywood	Sourdough Mountain Lookout	5.2	4,870	No	Strenuous
Stetattle Creek	Partially	Diablo Hollywood	Stetattle Creek trail end	3	1,100	No	Moderate
Diablo Dam	Yes	Diablo Reflector Bar	Road between Diablo Dam and Incline Lift	~0.5	~325	No	Moderate

Source: NPS 2019d.

Figure 4.8-14. Ross Lodge picnic shelter in Diablo townsite.

4.8.1.4 Gorge Lake

The 4.5-mile long Gorge Lake is largely undeveloped due to the steep topography of the shoreline and associated lack of access. SR 20 parallels the entire lake on the north side and crosses it at the upper end near Diablo.

There are two developed recreation facilities associated with the Gorge Lake shoreline – a campground and a boat launch. Gorge Lake Campground is located near the town of Diablo, just downstream of the mouth of Stetattle Creek. The campground is on land managed by NPS and is maintained by NPS. There are eight camp sites available; facilities include vault toilets, picnic tables, and fire rings (NPS 2019b). Water is not provided. In 2019, Gorge Lake Campground transitioned from a first-come, first-served basis to an advance reservation system on www.recreation.gov. The paved Gorge Lake boat launch is located adjacent to the campground (Figure 4.8-15). This site has a dock and is suitable for motorboats; it is the only public boat launch on Gorge Lake. The boat ramp and dock are on City Light land and used by City Light when boat access to Gorge Lake is needed.

Figure 4.8-15. Gorge Campground Boat Launch and Dock.

4.8.1.5 Newhalem Townsite

The Newhalem townsite is owned by City Light and is within the Project Boundary, except as noted below. A number of visitor amenities are provided in the townsite, including restrooms, an information center, parking, picnic tables, play equipment, trails, and interpretive signs. Newhalem is the last town for 70 miles for travelers headed east on SR 20. It is a popular stop for travelers and for visitors to RLNRA. The recreation facilities in Newhalem are described below.

Gorge Inn Museum

The Gorge Inn, one of the oldest buildings in Newhalem, includes a small museum that is open to the public during the week. The museum presents a social history of the Upper Skagit River Valley and the Skagit River Project, including Native American use of the area; Newhalem town life over the years; and J.D. Ross, the long-time superintendent and "Father of City Light" who conceived of and drove the construction of the Project (Figure 4.8-16). The Gorge Inn primarily serves meals to City Light staff and contractors who are working at the Project, but during the Skagit Tours season, the Gorge Inn also offers the Dam Good Chicken Dinner to the public two nights per week.

Figure 4.8-16. Gorge Inn Museum exhibits.

Gorge Powerhouse Visitor Gallery

The visitor gallery in Gorge Powerhouse is located above the powerhouse floor and has large glass windows that provide visitors with a view of the generators and other equipment on the generator floor below. Interpretive exhibits installed in 2016 provide information around four themes—how hydroelectricity is generated, the history of the Project, Project operations, and environmental programs included in the current Project license (Figure 4.8-17). The visitor gallery is open to the public daily from May through November (coinciding with when SR 20 is open).

Figure 4.8-17. Exhibits in Gorge Powerhouse Visitor Gallery.

Skagit Information Center

The Skagit Information Center is just off SR 20 on the main street in Newhalem (Figure 4.8-18). Completed in 2001, it includes restrooms, a breezeway with cases for maps, a large room with interpretive exhibits on Project history and information on the natural and cultural resources of the North Cascades, a retail store with maps and books, and outdoor exhibits including a hydropower turbine, sidewalk scaled mural of the Project, and a sculpture of a salmon redd by the artist Tom Jay. The information desk in the center is staffed by employees from City Light, NPS, and NCI from Memorial Day through the end of September.

Figure 4.8-18. Skagit Information Center in Newhalem.

Ladder Creek Falls and Garden

Ladder Creek Falls and Garden are located on land managed by NPS within the Project Boundary. City Light maintains the area and it is open year-round. Ladder Creek Falls (Figure 4.8-19) is a dramatic series of waterfalls in a slot canyon. A loop trail through the surrounding garden starts next to Gorge Powerhouse and winds up along the creek and adjacent hillside (Table 4.8-6). The trail and gardens were first developed in the mid-late 1920s by City Light as a tourist attraction. At the time, the garden featured exotic plants collected by J.D. Ross, outdoor lighting, and amplified music. After falling into disrepair for a few years, the trail and lights were refurbished by City Light in 2009 and several interpretive panels were added. Currently, colored LED lights illuminate the falls from one-half hour before sunset to 11 pm each night.

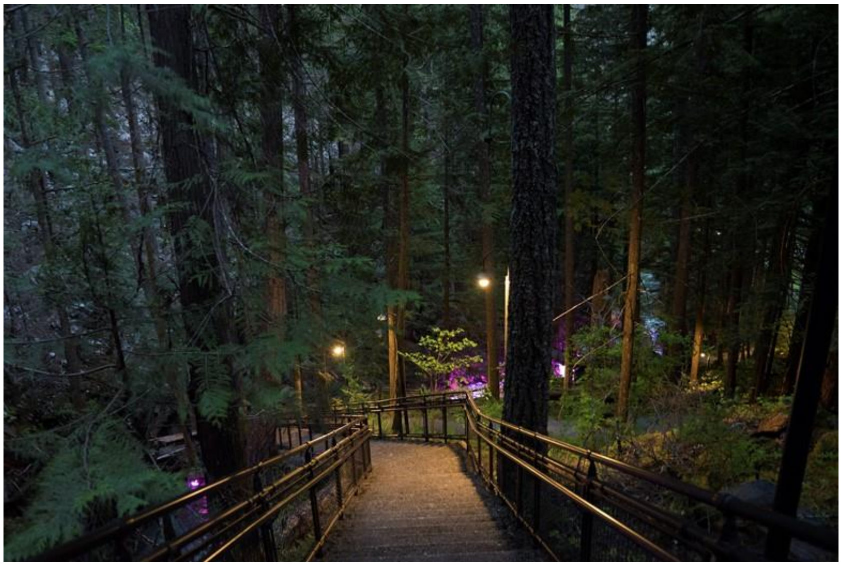


Figure 4.8-19. Ladder Creek Falls.

Table 4.8-6. Hiking trails associated with Newhalem townsite.

Trail	In FERC Boundary (Yes, No, Partially)	Start	End	Length (miles one-way)	Elevation gain (ft)	ADA Accessible	Difficulty
Ladder Creek Falls	Yes	Gorge Powerhouse Footbridge	Ladder Creek Falls	0.4	125	No	Easy
Trail of the Cedars	Yes	Newhalem Suspension Bridge	same as start	0.3	level	Yes	Easy

Source: NPS 2019d.

Trail of the Cedars

The Trail of the Cedars interpretive trail provides pedestrian access from Newhalem to the Newhalem Creek Powerhouse and links with another trail that leads to Newhalem Campground (Table 4.8-6). The trail is on land managed by NPS within the Project Boundary. It was constructed and is maintained by City Light. The trail begins at the suspension bridge at the end of Main Street in Newhalem, crosses the river, and then loops through the forest and along the river (Figure 4.8-20). Interpretive signs along the trail focus on the plants and natural history in the area. The Trail of the Cedars is open year-round and portions of it comply with outdoor accessibility guidelines for trails.

Figure 4.8-20. Bridge leading to Trail of the Cedars.

Other Newhalem Recreation/Visitor Facilities

Several other recreational and visitor service facilities are located in Newhalem. These include parking, play equipment, picnic tables, numerous interpretive signs (Figure 4.8-21), and public restrooms. City Light has placed two geocaches in Newhalem providing visitors with an opportunity to seek out hidden containers with Global Positioning System (GPS)-enabled devises; the geocaches contain information on the history of the Skagit River Project and the Skagit River. The City Light-run commissary, known as the Skagit General Store, has been a cornerstone of Newhalem since 1922. The store originally served the needs of employees and their families working on the Project. City Light continues to operate the store for employees and the public, providing a variety of packaged and prepared food items and beverages, camping supplies, ice, and firewood. It is open daily during the primary recreation season and operates on a reduced schedule during the off-season. A pamphlet with a self-guided walking tour of Newhalem is available for free to visitors who wish to explore the historical features of the townsite at their own pace.

Figure 4.8-21. Interpretive signs with view of Gorge Powerhouse.

Engine No. 6, a retired steam locomotive which was once used to transport people, equipment, and materials between Rockport and the Skagit River Project, is displayed along SR 20 next to the Skagit General Store (Figure 4.8-22). An associated interpretive sign informs visitors of the transportation available during construction of the Project. Next to the Engine No. 6 interpretive sign is an interpretive sign which focuses on the significance of the area surrounding present-day Newhalem to the Upper Skagit Indian Tribe. A public gazebo monument partially constructed out of industrial electrical equipment by the artist Dan Corson, known as the Temple of Power (Figure 4.8-23), is located to the west of the Skagit Information Center.

Figure 4.8-22. Engine No. 6.

Figure 4.8-23. Temple of Power.

4.8.1.6 RLNRA Downstream of Newhalem

NPS operates two developed campgrounds downstream of Newhalem: Goodell Creek Campground and the Newhalem Creek Campground; and three water-access sites: Goodell Creek Boat Access Site, Damnation Creek Boat-in Picnic Site, and Copper Creek Boat Access Site. All of these sites are located outside the Project Boundary, and operated and maintained by NPS.

The Newhalem Creek Campground is located on the south side of the Skagit River. The campground has 107 individual sites and two group sites (NPS 2019b). Two of the individual campsites are designated accessible. Thirteen sites are designated as walk-in sites. Facilities include water, picnic tables, fire rings, flush toilets, picnic shelters, recycling receptacles, garbage service, and an RV dump station. The walk-in sites include bear-resistant food storage containers. Campers can access the nearby NPS North Cascades Visitor Center and the Newhalem townsite via short hiking and interpretive trails originating in the campground (Table 4.8-7). The Newhalem Creek Campground can accommodate large RVs. Sites must be reserved in advance through www.recreation.gov. One site is set aside as a non-reservable bicycle campsite available on a first-come, first-served basis.

Table 4.8-7. Hiking trails associated with RLNRA downstream of Newhalem.

Trail	In FERC Boundary (Yes, No, Partially)	Start	End	Length (miles one-way)	Elevation Gain (ft)	ADA Accessible	Difficulty
Rock Shelter	No	Newhalem Campground Loop C	Rock Shelter	0.25	125	Yes	Easy
Skagit River Loop	No	North Cascades Visitor Center	same as start	1.8	100	Yes	Easy
Sterling Munro Trail	No	North Cascades Visitor Center	same as start	0.2	level	Yes	Easy
Thornton Lake and Trapper's Peak	No	Thornton Lakes Road	Thornton Lake and Trapper Peak	5.1	2,400 to ridge	No	Moderately strenuous

Source: NPS 2019d.

Goodell Creek Campground is located along the lower reaches of Goodell Creek on the north bank of the Skagit River just downstream from the mouth of the creek. The campground has 19 sites and two group sites (NPS 2019b). Facilities include water, picnic tables, fire rings, vault toilets, garbage service, and a covered picnic shelter. Goodell Creek Campground is suitable for tents and small RVs. Individual sites are available on a first-come, first-served basis; group sites must be reserved in advance.

The Goodell Creek Boat Access Site is located on the Skagit River adjacent to the Goodell Creek Campground. The site is suitable for launching non-motorized trailered boats into the Skagit River (Figure 4.8-24). This site is frequently used by private and commercial whitewater boaters.

Figure 4.8-24. Goodell Creek Boat Access Site.

From the Goodell Creek Boat Access Site, an 11-mile river run begins which ends at the Copper Creek Boat Access Site, though boaters may continue down the Skagit River crossing into the Wild and Scenic River stretch through the Mt. Baker-Snoqualmie National Forest and private land below Bacon Creek (see below). The site provides parking and a launch/take-out spot for non-motorized boats. In between the Goodell Creek and Copper Creek Boat Access Sites is the Damnation Creek Boat-in Picnic Site, a scenic stopping point for boaters along the river's edge. Features at the site include picnic tables and a vault toilet.

4.8.1.7 Skagit River Wild and Scenic River System

In November 1978, Congress designated 158.5 miles of the Skagit River and its tributaries (the Sauk, Suiattle, and Cascade rivers) as part of the National Wild and Scenic Rivers System (see Figure 4.8-41 below). The Skagit River segment of the Skagit River Wild and Scenic River System (Skagit System) begins near Bacon Creek just outside the RLNRA boundary and extends west for 58.5 miles to Sedro-Woolley. The USFS Mt. Baker-Snoqualmie National Forest has management responsibility for the Skagit System, including in-corridor land uses on federal lands and regulation of surface waters for recreational activities. The Skagit River segment of the Skagit System is designated as recreational, whereas the Sauk, Suiattle, and Cascade River segments of the Skagit System are designated as scenic.

The Skagit System provides opportunities for whitewater boating, floating, angling, and bald eagle viewing. There are two public boat launch sites located in the Skagit System on lands managed by the USFS that have been brought into the Project Boundary as non-continuous Project lands (Figures 4.8-25 and 4.8-26). These two sites are the Marblemount Boat Launch and Sauk River Boat Launch. The construction of both sites was funded by City Light under the current Project license but are currently managed by the USFS. The Marblemount site is located on the Skagit River, just upstream of the confluence with the Cascade River and about 12 miles downstream from Newhalem. The Sauk River site is about 35 miles from Newhalem, just off SR 530 near the confluence of the Sauk and Suiattle rivers. Both sites provide unpaved boat launches, parking, restrooms, and information kiosks. The Sauk River site also has group picnic shelter.

Figure 4.8-25. Informational kiosk and group picnic shelter at Sauk River Boat Launch.

Figure 4.8-26. Marblemount Boat Launch.

4.8.1.8 SR 20 Scenic Corridor

Managed by WSDOT, SR 20 is the northernmost route across the Cascade Mountain Range in Washington. The 140-mile stretch of SR 20 which spans from Twisp, Washington, to Sedro-Woolley has been designated a Washington State Scenic Byway. Due to weather, snow conditions, and avalanche danger, WSDOT generally closes SR 20 between the Ross Dam Trailhead on the west side and Mazama, Washington, on the east side between late November and mid-December each year. The highway reopens in the spring after clearing by WSDOT maintenance crews when conditions are deemed safe for drivers. Approximately 28 miles of SR 20 pass through the RLNRA from the western entrance to the eastern entrance. Portions of SR 20 are within the Project Boundary and the road offers scenic views of the Project in several locations. Numerous recreation sites discussed above are located along the corridor.

NPS manages four overlooks which provide views of the Project along SR 20. Two separate pullouts provide interpretive signs and views of Ross Lake near milepost 135 (Figures 4.8-27 and 4.8-28). The Diablo Lake Overlook near milepost 132 provides accessible parking, vault toilets, picnic facilities, interpretive signs and a geology display, and expansive views of Diablo Lake and surrounding mountain peaks (Figure 4.8-29 and 4.8-30).

Figure 4.8-27. More eastern of the two Ross Lake pullouts.

Figure 4.8-28. More western of the two Ross Lake pullouts.

Figure 4.8-29. Parking lot at Diablo Lake Overlook.

Figure 4.8-30. Interpretive signs at Diablo Lake Overlook.

The Gorge Creek Overlook is located at milepost 123.4. It consists of two paved parking lots on either side of Gorge Creek, vault restrooms, a trail, and interpretive opportunities. From the parking lots, visitors may walk across a bridge on SR 20 via a protected walkway, from which they can view Gorge Creek Falls and the ravine below (Figure 4.8-31). Alternatively, visitors may access the Gorge Overlook Trail from the more westerly of the two parking lots (Figure 4.8-32). The first section of the trail primarily runs parallel to the Gorge Creek ravine and provides 1,200 feet of universally accessible, paved trail, additional interpretive opportunities, and platforms from which to view Gorge Creek Falls, Gorge Lake, and Gorge Dam. The trail then continues on for 1,800 additional feet of gravel-surfaced trail which loops visitors back to the parking lot. Portions of the site are located within the Project Boundary but the site is managed by, and located on lands administered by NPS.

Figure 4.8-31. SR 20 Bridge at Gorge Creek Overlook.

Figure 4.8-32. Viewing platform at end of paved section of Gorge Overlook Trail; transition to gravel section.

NPS manages rock climbing on lands managed by NPS along SR 20 between the towns of Newhalem and Diablo at four designated Climbing Management Areas (CMA): Town Crags CMA, Newhalem East and West CMAs, and Diablo Crags CMA (Figure 4.8-33). Diablo Crags CMA is the only CMA located within the Project Boundary; however, climbers may park inside the Project Boundary at Newhalem and pass through Project lands to access Town Crags CMA and Newhalem East and West CMAs. Climbing is prohibited on adjacent City Light-owned lands.

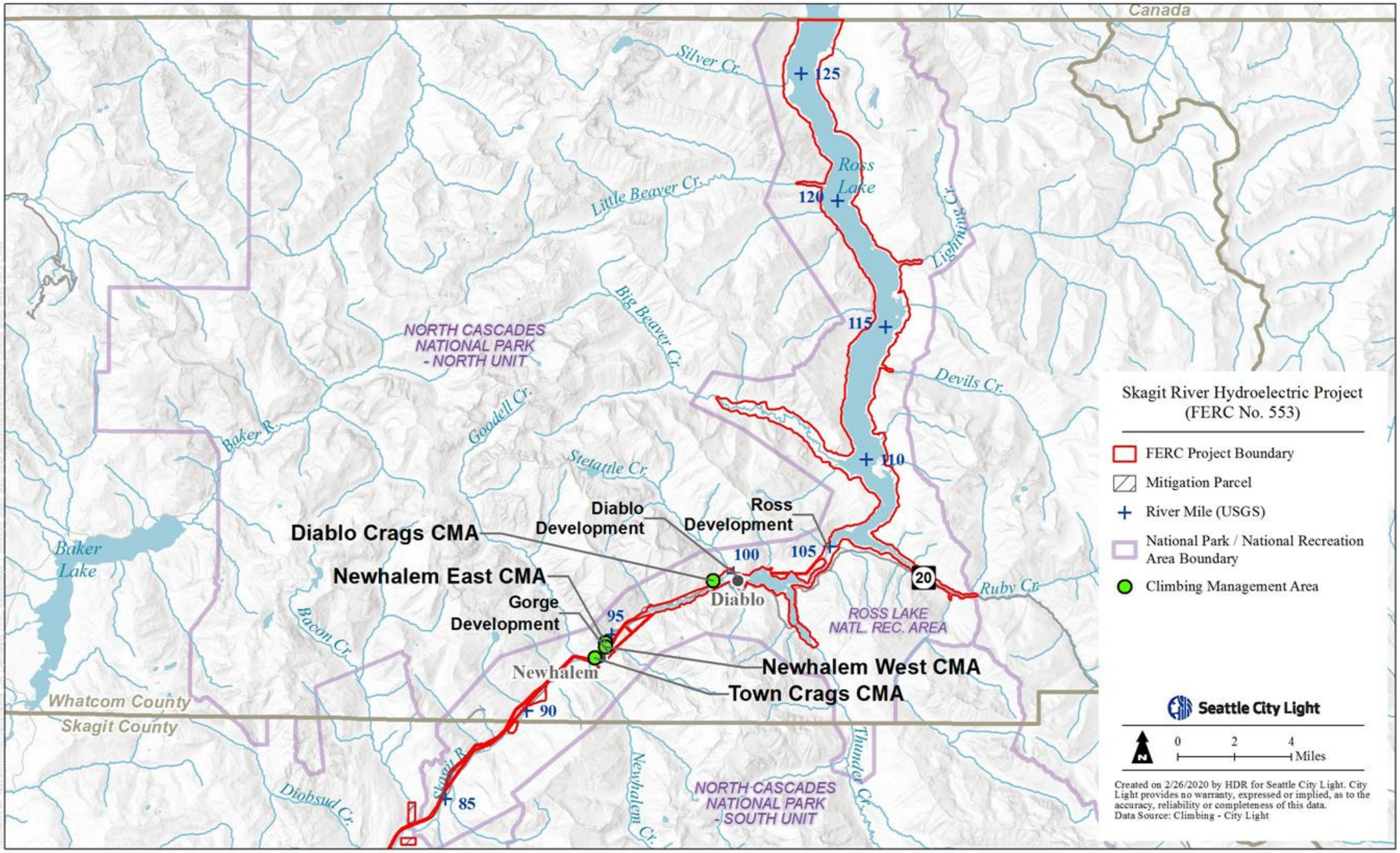


Figure 4.8-33. Climbing Management Areas in RLNRA relative to Project Boundary.

4.8.1.9 City Light-Owned Fish and Wildlife Mitigation Lands

City Light has acquired approximately 10,850 acres of river floodplain and upland forests in the Skagit, Sauk, and South Fork Nooksack watersheds (Figure 3.4-28) for protection and stewardship of habitat for fish and wildlife (City Light 2019a). All fish and wildlife mitigation lands are open to daytime non-motorized public recreation per a Policy Statement that is available online (http://www.seattle.gov/light/skagit/docs/SCL_Conservation_Lands_Public_Use_Policy_20180619.pdf). Overnight camping and fires are not permitted on mitigation lands, but the following activities are:

- Hiking and cross-country skiing;
- Horseback-riding on designated trails;
- Picnicking;
- Collection of berries, mushrooms, or plant material for non-commercial uses; activity must not result in degradation of habitat conditions;
- Hunting, per Washington state regulations or as provided by applicable federal laws or treaties, and in compliance with all applicable firearm safety and other laws and regulations; hunters must comply with all posted safety zones around adjacent residential areas;
- Fishing, subject to all applicable laws and regulations;
- Leashed pets; hunting dogs may be used off-leash while owner is actively hunting and must always remain under owner's control; and
- Use of licensed motorized vehicles on open improved roads when not gated.

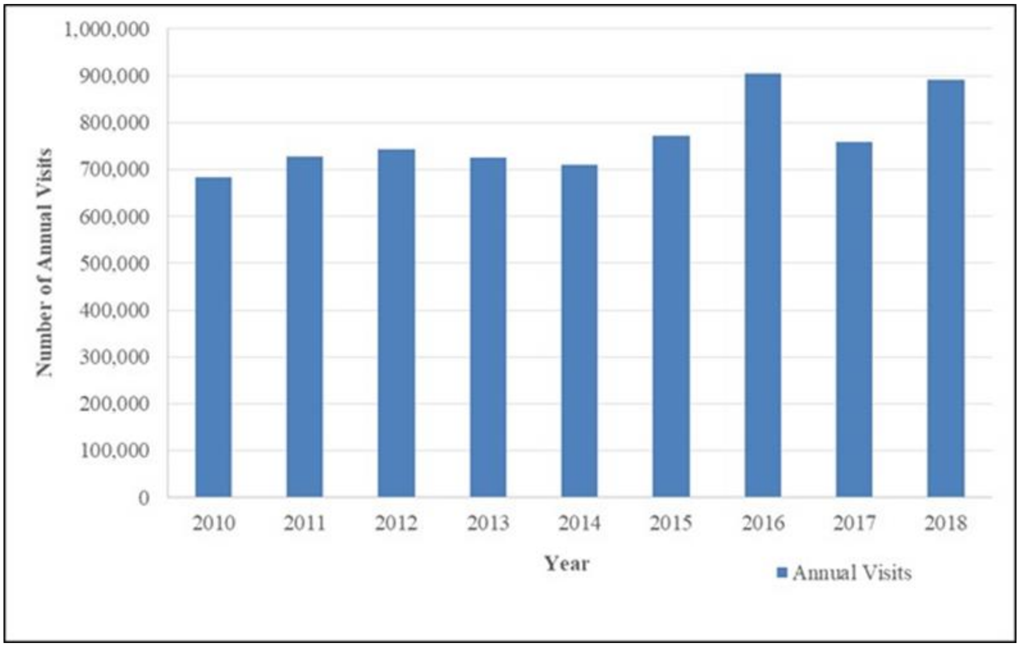
4.8.2 Current Recreational Use of Project Lands and Waters

This section describes visitor use in the broader RLNRA as well as specific facilities and waters inside the Project Boundary. The Project serves as a launching point for a range of recreation opportunities that extend far beyond the Project Boundary. Visitor use ranges from car trips through the Project vicinity on SR 20, with brief stops to view an interpretive display or photograph one of the Project waterbodies, to multiday stays in a frontcountry campground with excursions onto Project waters for day-use activities, or hikes into the backcountry for a wilderness camping experience.

Annual NPS reports about visitor use of the RLNRA (NPS 2019e) and City Light’s 2015 Licensed Hydropower Development Recreation Reports (City Light 2015a-c) present a picture of overall use of the Project and RLNRA. Visitors to the area come from across the United States and other countries; fewer than 60 percent of visitors to the RNLRA corridor are from Washington state (Swanson and Johnson 2007).

Visitation to the RLNRA is highest in the summer months of July and August with lower levels of recreation activity in the spring and fall shoulder seasons. Closure of SR 20 from November to mid-April limits visitor access to the area and associated recreation use. Several NPS facilities in the RLNRA close by the end of September. Similarly, the road gate at the U.S.-Canada border at Hozomeen is usually closed for the winter season by November.

Overall, visitation to RLNRA was relatively stable from 2010 to 2014 with approximately 700,000 visitors annually (NPS 2019e). Starting in 2015 through 2018, visitor use fluctuated between 760,000 to 900,000 (Figure 4.8-34). Peak visitor use occurred in 2016 with 905,418 visitors to the RLNRA coinciding with the National Park centennial celebration across the U.S. In 2017, visitor use declined to 759,656 visitors, on par with visitation numbers from 2010 to 2015. In 2018, visitation increased again to 892,044, likely coinciding with the 50-year anniversary for the establishment of North Cascades National Park.



Source: NPS 2019e.

Figure 4.8-34. Number of annual visits to the RLNRA (2010-2018).

City Light filed a FERC Licensed Hydropower Development Recreation Report (Form 80 report) in 2015 for each of the respective developments; Ross, Diablo, and Gorge. The Form 80 reports use the 2014 recreation season from May 1 to October 31 in the Project. NPS provided information to City Light for use in completing the Form 80 reports.

- The Ross development had 61,079 daytime visitors and 39,521 overnight users in 2014 (City Light 2015a). Peak weekend average use was 1,371 daytime visitors and 2,160 overnight stays. The backcountry campsites on Ross and the Ross Lake lodging were reported at 100 percent capacity utilization.
- The Diablo development had 208,994 daytime visitors and 22,659 overnight users in 2014 (City Light 2015b). Peak weekend average use was 4,686 daytime visitors and 1,341 overnight stays.
- The Gorge development had 222,987 daytime visitors and 25,428 overnight users in 2014 (City Light 2015c). Peak weekend average use was 4,914 daytime visitors and 1,467 overnight stays.

Records for specific facilities and recreation activities offered by City Light provide some information on visitor day use within the Project Boundary. Data sources for visitor use include

RLNRA visitor statistics, City Light records for tours, ELC program participation, and Ross Lake Resort records.

4.8.2.1 Diablo Lake Ferry Service

City Light provides a ferry service between the West Ferry Landing on lower Diablo Lake and the East Ferry Landing on upper Diablo Lake near Ross Dam two times each day during the summer recreation season. The *Cascadian*, with a 40-passenger capacity, transports visitors to Ross Lake Resort and backcountry hikers destined for Ross Lake and surrounding backcountry areas. A fee is charged.

4.8.2.2 Skagit Tours

City Light has a long history of providing tours of the Project. The first "tour" of the Project was for a garden club from Seattle in 1928 and the program rapidly expanded. The golden age of Skagit Tours was from 1930 to 1941 when tours lasted two days and consisted of the famous chicken dinner, train transportation, and a boat ride on Diablo Lake. Tourists stayed overnight in bunkhouses and J.D. Ross added unique visitor attractions, such as lights and music in Ladder Creek Falls and Garden, a zoo in Diablo, and monkeys on an island on Diablo Lake. Tours were discontinued after 1941 due to World War II and then construction activity which required the use of all facilities. One-day tours were resumed in 1956.

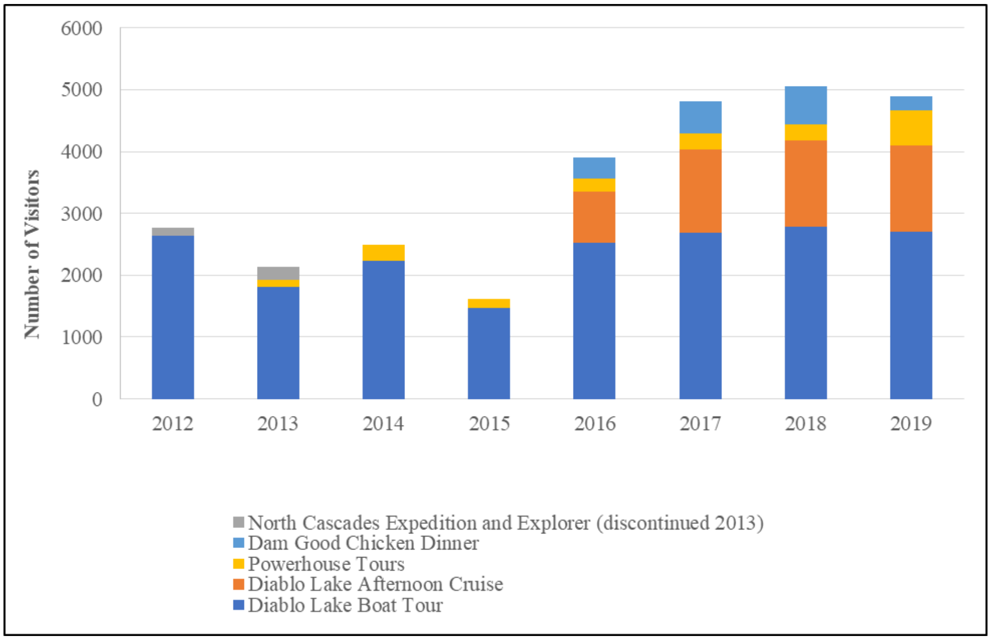
The official tour boat for Skagit Tours is the *Alice Ross IV*, named after J.D. Ross's wife. The original *Alice Ross*, built on Diablo Lake, was launched in 1935 and had a capacity of 300 passengers. The *Alice Ross II*, a former military landing craft, was launched in 1959 with a capacity of 100. Then came the *Alice Ross III* with a capacity of 70. Mid-way through the 2012 tour season, the *Alice Ross III* was taken out of service and replaced by the *Cascadian*, which had a capacity of 40 and was in service for the tours until the newly commissioned *Alice Ross IV* (Figure 4.8-35) was launched on Diablo Lake in 2016. The *Alice Ross IV* has a capacity of 49 and is ADA-accessible, with a heating and air conditioning system, toilet, audio system, and an open-air deck.

Figure 4.8-35. Alice Ross IV.

Tour focus and formats have evolved over the years. Today, the boat tours combine scenery with educational presentations on natural history, cultural resources, and Project operations. Tours are offered during the summer season (June – September). Boat tours depart from the Skagit Tour Dock located on the west shore of Diablo Lake accessed via the Diablo Dam Road. Daily tour schedules are posted on the City Light website. Advance reservations are required.

In 2011, City Light entered into a partnership with NCI and NPS to provide interpretation and meal services as part of the Skagit Tours. The most visible aspect of this partnership is the tour guides; there are six tour guides each year, two from each organization. NCI provides tour registration services, content development, logistics, and food service, and works with NPS on training and scheduling the guides. City Light currently offers four types of guided tours; each is described below.

- The **Diablo Lake Boat Tour** includes lunch at the ELC followed by a boat tour of Diablo Lake with a tour guide providing educational presentations on natural history, cultural resources, and Project operations. Over the past seven years the Diablo Lake Boat Tour has averaged 2,306 visitors annually. The boat currently used for tours on Diablo Lake—the *Alice Ross IV*—was commissioned in 2016 and has a capacity of 49 persons. Diablo Lake Boat Tour visitor numbers declined in 2015 due to a wildfire that closed SR 20 for several weeks and shortened the tour season (Figure 4.8-36).
- **Powerhouse Insiders Tour.** City Light has offered a variety of tours of the Gorge, Diablo, and Ross powerhouses over the years. The format and number of powerhouses included on the tour has changed from year to year. For the last three years, the tour format has included a walk through the Newhalem townsite to the Gorge Powerhouse for a visit to the generator floor and the inner workings of the powerhouse. The tour concludes with a picnic lunch.
- In 2016, City Light began offering a **Diablo Lake Afternoon Cruise** to accommodate visitors arriving later in the day or who did not have the time to commit to the longer Diablo Lake Boat Tour in the morning. The Afternoon Cruise is similar to the morning boat tour with the exception that it does not include lunch at the ELC. In 2019, 1,405 visitors took part in the Diablo Lake Afternoon Cruise (Figure 4.8-36).
- **Dam Good Chicken Dinner and Ladder Creek Falls by Night**. With the rehabilitation of the Gorge Inn in 2014, City Light began offering the Dam Good Chicken Dinner and Ladder Creek Falls by Night as part of the Skagit Tours Program in 2016. The program includes dinner at the Gorge Inn followed by an interpretive slide show at Currier Hall and a guided walk to Ladder Creek Falls and Garden. The dinner component of the program requires registration and a fee, while the slide show and guided walk are open to the public with no registration or fee required. Participation in the chicken dinner was 336, 513, 610, and 562 in 2016, 2017, 2018, and 2019 respectively (Figure 4.8-36).



Source: City Light 2019b.

Figure 4.8-36. City Light Tours (2012-2019).

4.8.2.3 North Cascades Environmental Learning Center

In partnership with NPS and City Light, NCI operates the ELC, which offers a variety of adult, youth, and family activities and programs. A summary of the types of programs available through the ELC as well as the number of participants in each program from 2014 through 2018 is provided in Table 4.8-8. Many ELC programs are multi-day and include overnight stays in the ELC lodging accommodations.

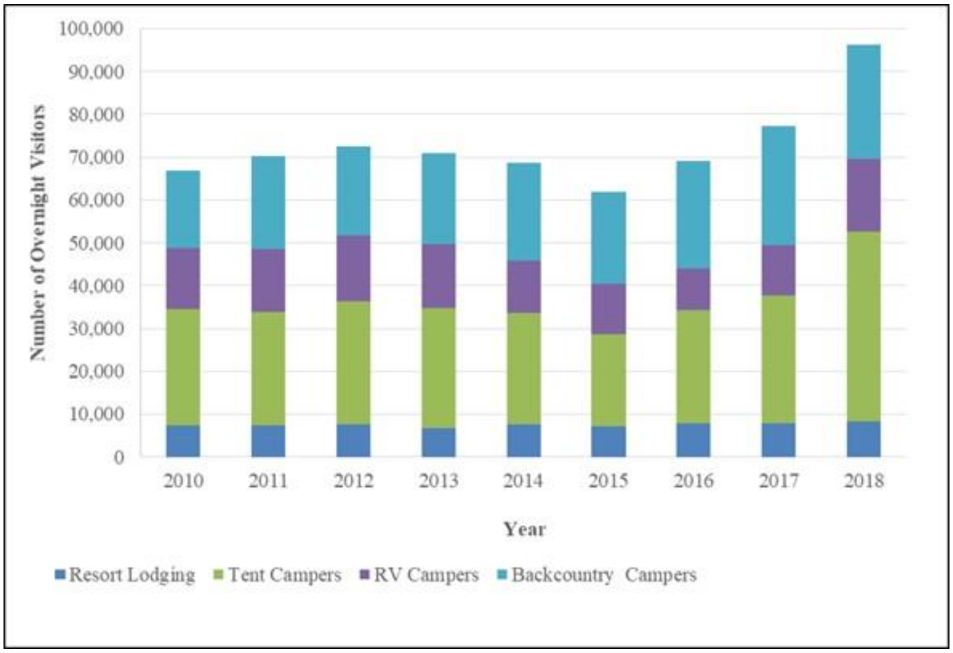
Table 4.8-8. Number of participants in programs available through the ELC (2014-2018).

Program	Number of Participants				
	2014	2015	2016	2017	2018
Adult and Family	1,542	1,422	1,845	2,003	1,935
Youth Leadership	164	87	77	92	79
Community	425	291	220	174	195
School Programs	2,781	2,798	3,219	3,268	4,265
Graduate	17	24	32	28	25
Conferences	1,174	650	999	1,057	800
Skagit Tours	2,494	1,589	4,048	4,807	4,966
Total	**8,597**	**6,861**	**10,440**	**11,429**	**12,265**

Source: NCI 2019.

4.8.2.4 Overnight Use in the Skagit River Project and RLNRA

All overnight stays in the RLNRA, including the Project Boundary, must be at an established frontcountry campground, a designated backcountry campsite, or at the Ross Lake Resort. NPS manages permitting for all frontcountry and backcountry camping. Figure 4.8- 37 illustrates the number of overnight stays by type in the RLNRA from 2010 to 2018. Types of overnight stays include Ross Lake Resort lodging, backcountry camping, and frontcountry tent and RV camping. Backcountry camping within the RLNRA includes 19 sites on Ross Lake, three boat-in sites on Diablo Lake, and numerous other sites outside the Project Boundary. Frontcountry camping is available at Hozomeen on Ross Lake, Colonial Creek Campground on Diablo Lake, Gorge Lake Campground, and Goodell and Newhalem Campgrounds in the RLNRA downstream of the Gorge Powerhouse. An overnight stay is defined as one night within RLNRA by a visitor.



Source: NPS 2019e.

Figure 4.8-37. Overnight visits in RLNRA (2010-2018).

Ross Lake Resort

The Ross Lake Resort is open from June through October and is the only lodging facility on Ross Lake. The average annual overnight stays at Ross Lake Resort from 2014 through 2018 was 7,534. Ross Lake Resort overnight visits exhibited little fluctuation in the nine-year period from 2010 to 2018 (Figure 4.8-37). The relatively stable Ross Lake Resort stays likely indicate that the resort has been operating at or near capacity for the last several years.

Backcountry Camping

Backcountry camping in RLNRA increased in 2016, 2017, and 2018 (Figure 4.8-37). In an effort to better manage backcountry visitation to prevent overcrowding and resource damage, and to provide for opportunities for solitude and a quality backcountry experience for all visitors, NPS implements a year-round permit system for all overnight stays in the backcountry of RLNRA including boat-in campsites on Project lands (NPS 2019g). In addition, backcountry permit group size is limited to 12 people within all trail corridors, water routes, and camps to protect wilderness values. Popular areas can be busy during the height of summer, and permits can fill quickly. Permits specify route itineraries including campsite locations accessed via trails and water routes.

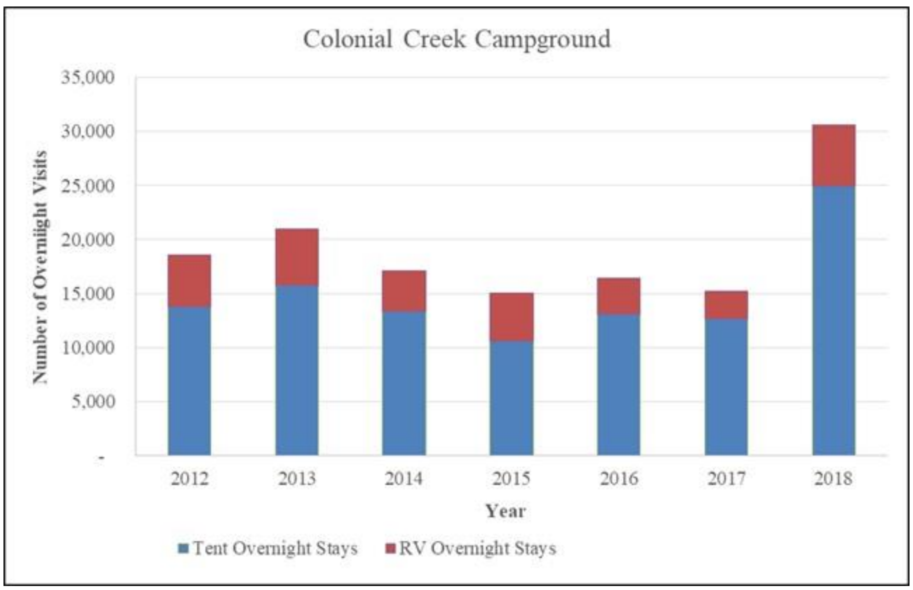
Backcountry permits are obtained through the online reservation system for a fee. The advance reservation system is open for applications from March 15 to April 15 annually. Advance reservations are available for up to 60 percent of the sites. In 2019, 2,380 advance reservation applications were submitted for the North Cascades National Park Complex (NPS 2019h). The remainder of backcountry permits are available the day before or day of a desired trip start date on a first-come basis. Walk-up permits are issued in person only at ranger stations within or around the park. There is no fee for first-come permits.

Frontcountry Camping

The annual number of tent campers in RLNRA was relatively stable from 2010 to 2014 ranging from a high of 28,871 in 2012 to a low of 25,862 in 2014. In 2015, tent camping declined to 21,460, the lowest number of annual tent campers in RLNRA for the nine-year period (Figure 4.8-37), but this was likely due to the Goodell Fire, which closed the west side of the RLNRA to visitors for several weeks in August and shut down a portion of Newhalem Campground for the rest of the season. The annual number of tent campers in RLNRA increased steadily from 2016 through 2018 with a peak of 44,192 tent campers in 2018, more than double the number reported for 2015. The increase may be due to NPS actively marketing the centennial celebration in 2016 (NPS 2019f; FiveThirtyEight 2016), and North Cascades 50-year anniversary celebration in 2018.

RV camping has fluctuated between 9,684 and 17,022 overnight stays from 2010 to 2018. The lowest number of RV camping visits occurred in 2016 with 9,684 visits.

Overnight stays in Colonial Creek Campground, the only campground that overlaps that Project Boundary, were tabulated for RVs and tents from 2012 to 2018 (Figure 4.8-38). RV overnight stays ranged from 2,609 in 2017 to 5,672 in 2018 with an average of 4,272 RV overnight stays annually. Overnight tent stays ranged from 10,550 in 2015 to 24,924 in 2018 with an average of 14,861 annually.



Source: NPS 2019f.

Figure 4.8-38. Colonial Creek Campground overnight stays (2012-2018).

4.8.2.5 Hunting and Angling

Hunting is permitted throughout RLNRA including lands inside the Project Boundary in accordance with state law and tribal hunting regulations. Hunting is not allowed in areas of high visitor use or areas with restricted public access such as Project dams and powerhouses (Figure 4.8-39). City Light-owned lands are generally not posted with the exception of the Newhalem Ponds (Agg Ponds), which is fish mitigation land with limited access, and the established safety zones on the Savage Slough mitigation lands. All persons regardless of age must possess a valid hunting license issued by the WDFW. Lead-based ammunition is prohibited in RLNRA.

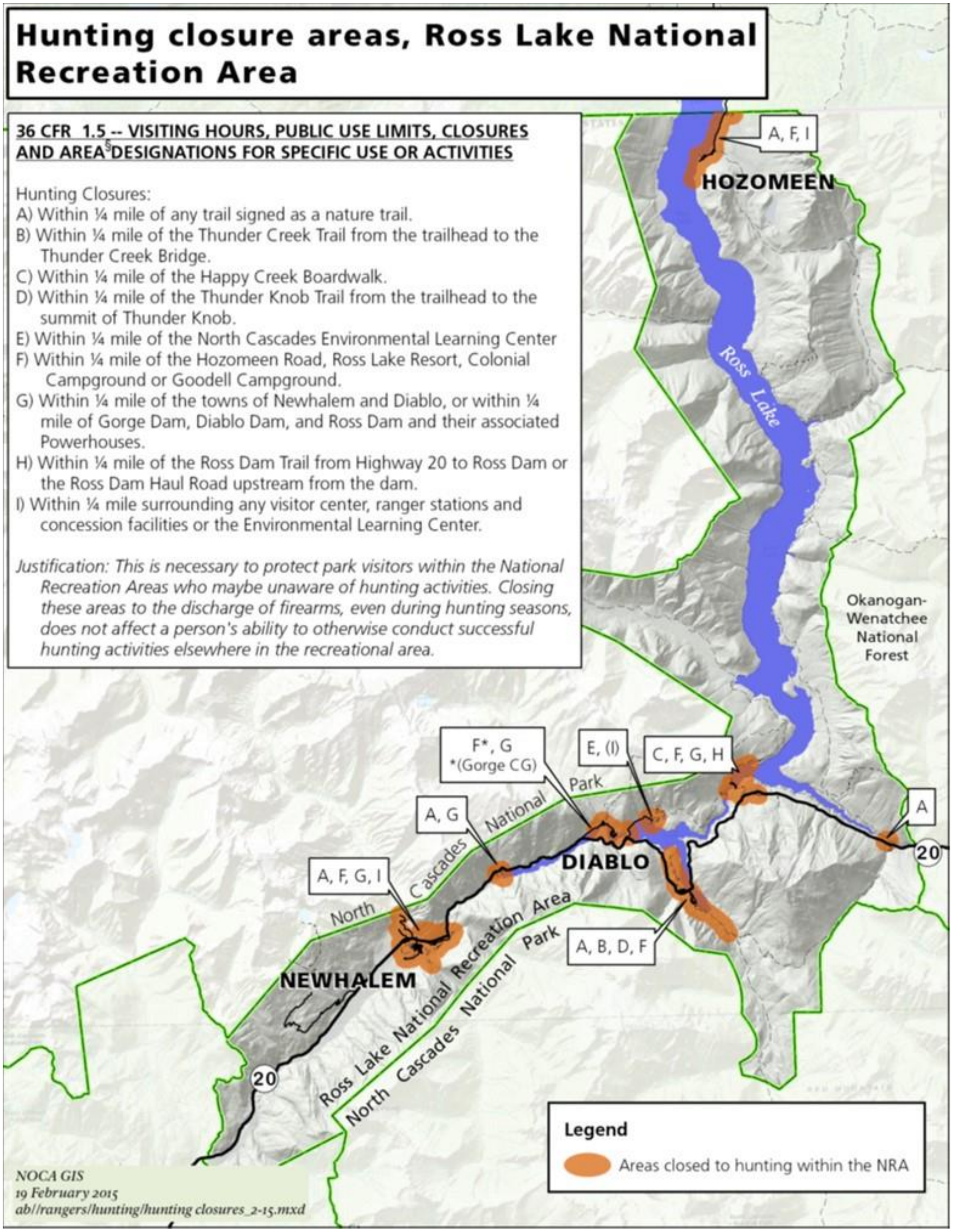
The entirety of RLNRA resides in WDFW GMU 426. Harvest numbers summarized for GMU 426 represent a small fraction of harvest relative to the total WDFW regional harvest numbers. The most popular big game species hunted in GMU 426 are deer and black bear. Annual deer harvest in the GMU 426 ranged from 2-20 animals with an average harvest of 11.8 deer per year. Annual black bear harvest from the GMU 426 ranged from 1-8 animals with an average harvest of 3.8 bears per year (Christophersen 2015).

Fishing is permitted on all three Project reservoirs and the mainstem Skagit River. Seasons and tackle restrictions vary by respective reservoir and river segment. Anglers 15 years and older must have a Washington State fishing license. Bull Trout/Dolly Varden are protected and must be released from all Project waters and river segments.

Ross Lake is open to fishing July 1 to October 31 (WDFW 2019). Tackle is restricted to barbless artificial flies and lures. Daily limit includes five Eastern Brook Trout and one Rainbow Trout 16 inches or greater. In 2011, NPS conducted an access-point angler survey in Ross Lake (Anthony and Rawhouser 2017). Objectives of the survey included estimating total fishing effort and catch and harvest rates for the entire lake. Total angling effort from July 1 through September 30 was 14,860 hours. Total catch for Ross Lake was 7,612 fish. Over 94 percent of the catch was Rainbow Trout, equaling 7,160 fish, of which 2,215 were harvested. Native char and Brook Trout were also caught. Catch-per-unit-effort was 0.5 fish per hour.

Fishing is open year-round on Diablo and Gorge lakes (WDFW 2019). Tackle permitted includes bait, artificial flies, and lures. The daily limit is five trout with no minimum size restriction. Eastern Brook Trout do not count toward the daily limit. In 2003, WDFW conducted creel surveys on Diablo Lake and Gorge Lake. Total angling effort from July through September was 191 hours for Diablo Lake and 102 hours for Gorge Lake. Rainbow Trout dominated the survey in Diablo Lake while native char were caught in larger numbers in Gorge Lake (Dowen 2004).

Fishing on the Skagit River from Gorge Powerhouse to the Marblemount Bridge is open June 1 to January 31. The river within RLNRA is closed to motorized boats, which limits fishing in this reach. This section of the Skagit is designated catch and release for all game fish. Hatchery steelhead fishing is open from June 1 to January 31. Daily limit is two hatchery steelhead with a minimum size limit of 20 inches.



Source: Nelson 2019.

Figure 4.8-39. Areas closed to hunting within RLNRA.

4.8.2.6 Whitewater Boating

Several tributary streams flowing into Ross and Diablo lakes are listed as whitewater opportunities by American Whitewater (American Whitewater 2019). Table 4.8-9 lists the stream, access locations, difficulty and length. All of these tributaries are free flowing streams outside the Project Boundary for the majority of their length. The Little Beaver and Lightning Creek whitewater sites are accessed by a combination of paddling across Ross Lake then hiking up the tributary to the put-in located outside the Project Boundary. The put-in and take-outs listed for the two runs on Granite Creek are located on SR 20 outside the Project Boundary. Thunder Creek is a free-flowing tributary flowing into Thunder Arm on Diablo Lake. American Whitewater describes this as a backcountry paddling destination requiring paddlers to hike up the Thunder Creek trail for 4.1 miles to an undesignated put-in location. Paddlers take-out on Diablo Lake at Colonial Creek Campground. The majority of the paddling opportunity on Thunder Creek is outside the Project Boundary.

Table 4.8-9. Whitewater paddling opportunities on tributaries entering Ross and Diablo lakes.

Name	Put-in	Take-out	Difficulty[1]	Length (miles)
Upper Granite Creek	SR 20 Bridge over Granite Cr (Milepost 148.2)	East Bank trailhead (Milepost 143.1)	IV-V (V+)	4.6
Granite Creek to Ruby River	SR 20 (Milepost 143.1)	East Bank trailhead (Milepost 138.3)	IV	5
Lightning Creek	Boundary Trail	Ross Lake	III-IV (V)	3.5
Little Beaver	Little Beaver Trail	Ross Lake	IV-V	2.5
Thunder Creek	4.1 miles up Thunder Cr trail	Colonial Creek Campground	IV-V	4.1

Source: American Whitewater 2019.
1 International Scale of Whitewater Difficulty.

4.8.2.7 Fish and Wildlife Mitigation Lands

Fish and wildlife mitigation lands are open to the public for non-motorized day-use recreation. The primary purpose of the mitigation lands is for wildlife protection and habitat conservation. Visitor counts are not conducted in the mitigation lands. Known uses include hunting, fishing, and wildlife viewing.

4.8.2.8 Skagit River Access and Use Downstream of Newhalem

The Skagit River downstream of Newhalem through RLNRA is closed to motorized boats except for those used by City Light, tribes, and agencies for monitoring purposes, and there are no publically available ramps to launch motorized boats until Marblemount. However, sections of the Skagit River from Goodell Creek to Rockport are popular for rafting and kayaking, especially in the winter for bald eagle viewing. The Marblemount and Sauk River boat launch sites are managed by the Mt. Baker-Snoqualmie National Forest (USFS) and provide access for all types of watercraft to downstream sections of the Skagit River. USFS oversees public and commercial launches at the Marblemount and Sauk River boat launches. Similarly, the NPS oversees the non-motorized boat launches at Goodell, Damnation, and Copper creeks.

4.8.2.9 Trails

Hiking and stock trails are numerous within and adjacent to the Skagit River Project. Hiking is a popular activity, and trail-types range from fully accessible day hiking trails in the Newhalem townsite to wilderness backcountry trails in the vicinity of the Ross Lake portion of the Project. Trail use counts are not maintained separately from other uses of Project and RLNRA recreation facilities.

4.8.3 Shoreline Buffer Zones

The three reservoirs and the associated Project Boundary lie wholly within the RNLRA, which is managed by the NPS for recreation and resource protection. There are no designated shoreline zone buffers in RLNRA. Downstream of the Project, NPS manages the Skagit River and adjacent riparian corridor within RLNRA for natural and cultural resource preservation and river recreation (NPS 2012). This zone is approximately ¼ mile on either side of the Skagit River through this area.

4.8.4 Recreation-Related Goals and Needs Identified in Agency Management Plans

A number of management plans developed by federal, state, and local agencies identify recreation-related goals and objectives to manage the current and future needs for recreation in the Project vicinity. NPS has jurisdiction of most of the lands within the Project Boundary, while the state and local management plans are applicable to mitigation lands and the transmission line ROW. The USFS manages recreation in the Skagit River Wild and Scenic River System downstream of the Project. Management plans relevant to the Skagit River Project include the following:

- Ross Lake National Recreation Area General Management Plan (NPS 2012)
- The Skagit Wild and Scenic River Management Plan (USFS 1983)
- Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan (USFS 1990)
- Stephen Mather Wilderness Management Plan (NPS 1989)
- Washington State Recreation and Conservation Plan, 2018-2022 (Washington State Recreation and Conservation Office 2017)
- Whatcom County Comprehensive Plan (Whatcom County 2016)
- Skagit County Comprehensive Plan, Update (Skagit County 2016)
- Snohomish County Comprehensive Plan (Snohomish County 2015)

Each of the above identified plans is discussed below, including a description of the plan and relevant goals, policies and/or objectives that pertain to recreation and are potentially relevant to the Project relicensing.

The Project Boundary terminates in Washington State, at the U.S.-Canada border. The Skagit Valley Provincial Park Management Plan (1998) recognizes the integral role of the Skagit Valley Provincial Park as a component of an internationally significant group of protected areas within the United States and Canada and recommends cooperation with federal, state, and provincial jurisdictions. In cooperation with NPS, the plan also proposes to develop visitor services at Ross Lake including an international visitor center along with sani-station, power, and water and sewer facilities; and addresses the need to establish a stabilized water level for Ross Lake during the summer months. This plan establishes that the purpose of the Skagit Valley Provincial Park is to maintain the primitive atmosphere that the park currently possesses and presents, including its use as a gateway to North Cascades National Park and RLNRA in the United States.

4.8.4.1 Federal Recreation-Related Management Plans

USFS and NPS are the federal land management agencies in the Project vicinity. Both have published management plans with recreation management-related sections.

Ross Lake National Recreation Area General Management Plan (2012)

The RLNRA GMP articulates a vision and overall management philosophy to guide decision-making by current and future NPS management teams during the next 15 to 20 years and the scope of the plan is nearly coincident with the Project Boundary. This plan presents management strategies for resource protection and preservation, education and interpretation, visitor use and facilities, land protection and boundaries, and long-term O&M of RLNRA. It replaces portions of the North Cascades National Park Complex GMP, completed in 1988 that provided guidance for the management of RLNRA.

Recreation-related management strategies include the following:

- Identify visitor carrying capacities for managing public use and ways to monitor for and address unacceptable impacts on resources and visitor experiences.
- Monitor visitor comments on issues such as crowding, encounters with other visitors in the backcountry, availability of campsites at busy times of the year, and availability of parking.
- Conduct periodic visitor surveys to stay informed of changing visitor demographics and desires to better tailor programs to visitor needs and desires.
- Develop outreach programs for and with schools, tribes, and community organizations.
- Provide a variety of educational opportunities in RLNRA with continued facility-based contacts and guided activities. Web-based education would be provided. Some activities could be for a fee.
- Coordinate education programs with partners and focus on improving the general understanding of RLNRA’s natural and cultural resources, biodiversity, the protection of resources and natural processes, research, stewardship, wilderness values, and recreational and visitor opportunities.
- Require that all motorboats operating in RLNRA have four-stroke engines, direct-injection two-stroke engines, or equivalent technology to preserve visitor experience, soundscapes, and water quality (NPS 2012).

The GMP divides RLNRA into five management zones reflective of resource condition, level of development, and visitor experience (Figure 4.8-40). The respective management zones are summarized below:

> **Frontcountry Zone** – A wide variety of high quality recreational and educational visitor opportunities and facilities are provided in this zone. Natural and cultural resource

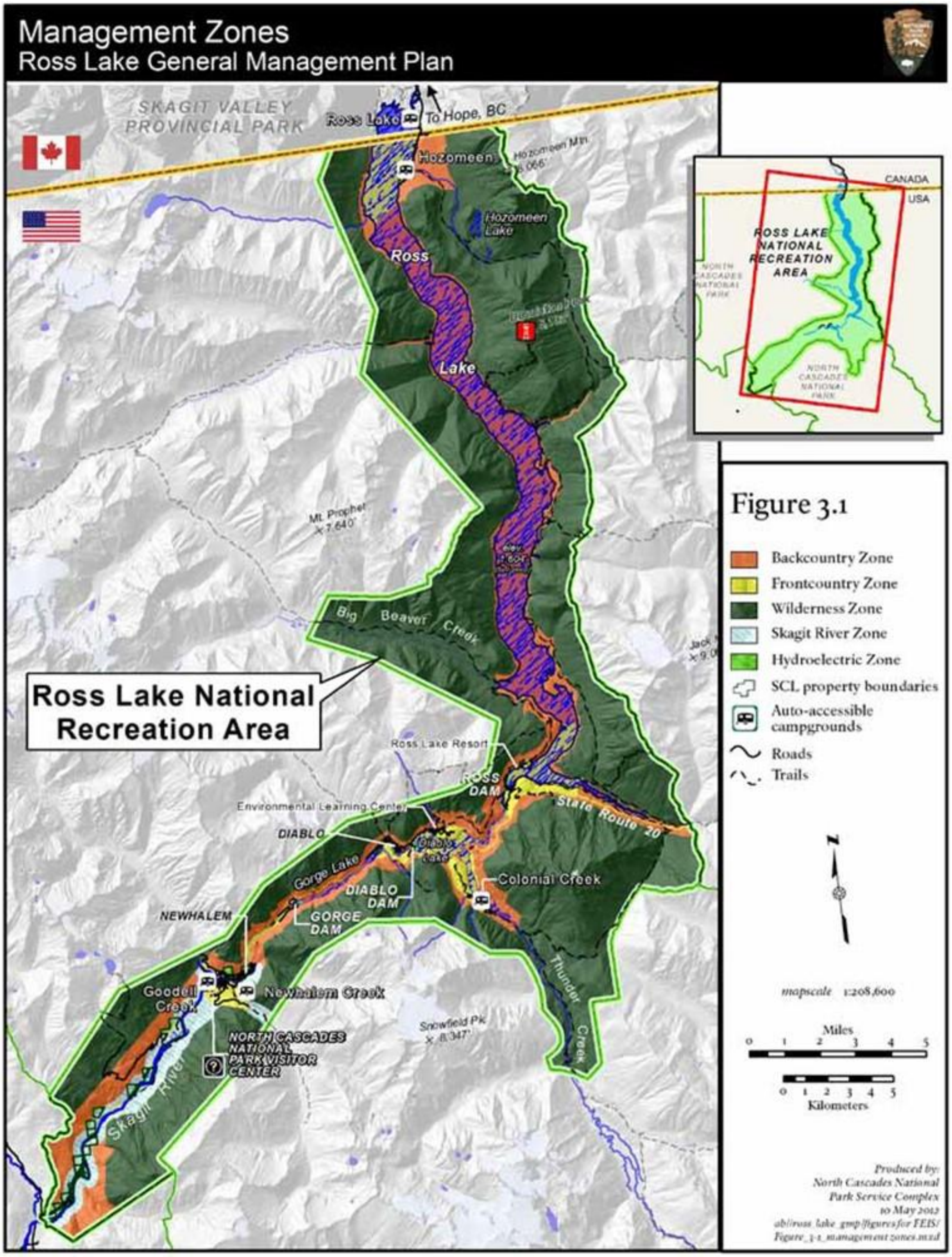
conditions are maintained with some modification to accommodate visitor or management needs. The scenic east-west route through the North Cascades along SR 20 is entirely located within this zone, along with most of Gorge and Diablo Lakes, the ELC, Hozomeen, northern and southern portions of Ross Lake, Hozomeen, and adjacent developed areas are primarily located in this zone.

Backcountry Zone – Limited visitor facilities provide a sense of remoteness and immersion in nature within a mountainous wilderness setting. Natural and cultural resource conditions are preserved, and some resources may be enhanced through restoration. This zone includes undeveloped areas beyond SR 20 road prism and other areas that are dominated by natural conditions with structured opportunities for visitor recreation, including most of Gorge Lake and the entire surface of Ross Lake and its shoreline from Cougar Island to Silver Creek.

Wilderness Zone – A wilderness experience, limited, primitive visitor facilities, and very few encounters with other visitors is the emphasis for visitor use in the Wilderness Zone. Natural and cultural resource conditions are preserved and resource stewardship and restoration is the primary focus. This zone includes designated wilderness established as part of the Washington Park Wilderness Act of 1988 and potential wilderness are located in this zone.

Skagit River Zone – Natural and cultural resource preservation of the Skagit River corridor and visitor facilities associated with river recreation are the focus of this zone. The Skagit River and much of the adjacent riparian corridor below Gorge Powerhouse in Newhalem and up Goodell Creek to the wilderness boundary are located in this zone, except for the Newhalem area. This zone is approximately ¼ mile on either side of the Skagit River through most areas.

Hydroelectric Zone – City Light operations are paramount to resource conditions and visitor experience in this zone. City Light facilities and primary management areas, including the hydroelectric projects at Ross, Diablo, and Gorge Dams, towns, and the Gorge Bypass Reach are located in this zone. Most visitor experiences are linked to learning about hydroelectricity and are frontcountry recreational activities.



Source: NPS 2012.

Figure 4.8-40. National Park Service management zones prescribed for RLNRA.

The Skagit Wild and Scenic River Management Plan (1983)

The Skagit Wild and Scenic River Management Plan (SRMP) was developed and implemented in 1984 after the Wild and Scenic River was designated in 1978. The Skagit Wild and Scenic River is managed by the Mt. Baker-Snoqualmie National Forest. The SRMP management goals include:

- Provide for maximum involvement of local, County, State, and other federal agencies in the management and administration of the Skagit Wild and Scenic River System.
- Minimize conflicts between public use and private landowners within the Wild and Scenic River corridor.
- Provide for the conservation and continuation of the patterns of primitive, rural, and pastoral landscapes.
- Protect and enhance the various landscapes visible from the river, as well as from its banks.
- Provide for public access to and along the banks of the Skagit, Cascade, Sauk and Suiattle rivers consistent with other resource capabilities, and the 1982 inter-agency guidelines.
- Protect the cultural resources within the Skagit Wild and Scenic River System corridor.
- Provide coordination with NPS river management of the Bald Eagle Natural Area.
- Improve the opportunities for a wide variety of water-related recreation opportunities consistent with river character and 1968 Wild and Scenic River Act.
- Maintain and enhance free-flowing characteristics of the rivers.

Recreation-related management direction includes policies to determine recreation demands and provide adequate resource protection:

- Develop strategies, initiate interim procedures, and request Pacific Northwest Research Station to determine recreation demands, user-conflict resolution, resource capabilities, and proper levels of use and management.
- Provide for the ongoing monitoring necessary to establish resource degradation thresholds so that use can be positively managed.
- Provide recreation opportunities and a forest environment that is based on a natural or near natural setting throughout the river management zone.
- Use recreation experience levels, as modified by this plan, as a guideline for recreation management and development within the river corridor.
- Develop or upgrade boat access sites to provide suitable facilities for raft launching and takeout.

Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan (1990)

The Mt. Baker-Snoqualmie National Forest LRMP embodies the provisions of the National Forest Management Act of 1976, the implementing regulations, and other guiding documents. Land use determinants, standards and guidelines, and management prescriptions constitute a statement of the Forest Plan's management direction. The LRMP guides natural resource management activities and establishes management standards and guidelines for the Mt. Baker-Snoqualmie National Forest. It describes resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management. Mt. Baker-Snoqualmie National Forest LRMP Recreation Goals include:

- Provide a broad spectrum of recreation opportunities, with an emphasis on those which require a natural setting.
- Be responsive to a greater diversity of forest customers by emphasizing the needs of the very young and old, the disabled, and those of culturally and economically diverse background.
- Become more knowledgeable of the Mt. Baker-Snoqualmie National Forest customers. Embark on market research techniques to ensure that recreation facilities, opportunities and services focus on the needs of Mt. Baker-Snoqualmie National Forest customers.
- Encourage a sense of ownership through expanded Interpretation and Education activities; emphasize traditional values of "conservation," and market the "special places," special activities and special opportunities of the Mt. Baker-Snoqualmie National Forest.
- Provide a full spectrum of recreation facilities (from full service resorts to trailheads) to serve all of the recreation users, providing amenities (hot water, showers, trailer dumps) where necessary and appropriate, that allow the recreating customer to enjoy the natural setting while creating a sense of quality, comfort, and security.

Stephen Mather Wilderness Management Plan (1989)

The Stephen Mather Wilderness Management Plan provides the North Cascades National Park Service Complex with management guidance for protecting the wilderness character of the Stephen Mather Wilderness. The plan is focused on wilderness management in the form of preservation and conservation as a result of the Washington Park Wilderness Act of 1988 (PL 100-688). Management goals and objectives apply to federal lands designated as wilderness, and include:

- To manage the wilderness environment so as to conserve, maintain, enhance, or restore the wilderness natural resources and those ecological relationships and processes that would prevail were it not for human influences.
- To encourage wise visitor use of the resource through education, example, and innovative management.
- To strive for management techniques that will allow visitors maximum freedom in the wilderness without sacrificing the quality of the natural resources.
- To meet the challenges and spirit of the 1916 Park Service Organic Act and the 1988 Washington National Parks Wilderness Act.
- To ensure maximum freedom of use without sacrificing the quality of the wilderness natural resources.
- To pass the wilderness natural resources and spirit of the North Cascades on to the next generation unimpaired.

4.8.4.2 Washington State Recreation and Conservation Plan

The **Washington State Recreation and Conservation Plan (2018-2022)** is intended to help decision-makers better understand recreation and conservation issues statewide and to maintain

Washington's eligibility for federal Land and Water Conservation Fund dollars. The 2018-2022 Recreation and Conservation Plan provides strategic direction for how local, regional, state, and federal agencies, together with tribal governments, and private and non-profit partners, can ensure the effective and adequate provision of outdoor recreation and conservation to meet the needs of Washington State residents. It lays the foundation and context that will help guide decisions and determine how to invest limited funding on the most important recreation and conservation needs.

4.8.4.3 Local Plans with Recreation Management Elements

The Washington State Growth Management Act (GMA) Chapter 36.70A RCW encourages counties to adopt an optional "Recreation Element" under RCW 36.70A.080(1)(c). The Project lies within the local counties of Whatcom, Skagit, and Snohomish, all of which have Comprehensive Plans that include Recreation Elements and are discussed below.

Whatcom County Comprehensive Plan (2016)

The Whatcom County Comprehensive Plan included a Recreation Element (Chapter 9) in coordination with the Land Use element, including Open Space & Environment; Capital Facilities; Transportation; and Economics. The Recreation Element is also responsive to, informs, and relies on the Whatcom County Parks, Recreation and Open Space (CPROS) Plan.

The Recreation Element of the Whatcom County Comprehensive Plan includes a detailed list of policies related to acquisition, development, and maintenance of recreation facilities in the county, one of which is to work toward partnering with other agencies and the public to accomplish recreational goals. The recreation-related goals include:

- Address countywide recreational needs by adequate provision of regional parks.
- Provide multi-use camping parks to serve county resident needs as well as provide a tourism draw.
- Expand outdoor recreation opportunities for county residents by providing enjoyable trails for hiking, horseback riding, bicycling, walking, boating, and other trail activities in a safe environment.
- Provide specialized recreation areas taking advantage of unique opportunities to serve both county residents and visitors.
- Recognize the shoreline as one of Whatcom County's unique assets and provide adequate physical and visual access for present and future generations.
- Coordinate with Washington DNR to provide off-road vehicle opportunities.
- Encourage multi-use indoor activity centers to meet the needs of the population, using public and private partnerships where possible.
- As economically feasible, continue to implement the Whatcom County CPROS Plan goals and policies through adoption of the Whatcom County Comprehensive Plan Six-year Capital Improvement Program (CIP).
- Develop a stronger financial base for recreational services.

Skagit County Comprehensive Plan (2016)

The Skagit County Comprehensive Plan, Parks and Recreation Element, includes goals for the retention of open space, the enhancement of recreational opportunities, the conservation of fish and wildlife habitat, better access to natural resource lands and water, and the development of parks and recreational facilities. To be eligible for Washington State grants, the Recreational Conservation Office requires that the plan be updated every six years. The Skagit County Comprehensive Plan received a number of Amendments in 2019; the Parks and Recreation Element was not amended.

The overall goal of the Skagit County Parks and Recreation Element is to "develop, renovate, and acquire a system of parks, recreational facilities, and open space that is attractive, safe, functional, and accessible to all citizens of Skagit County." Priority goals include: to retain the connection with the outdoors and the wildlife it hosts as well as provide for passive and active recreation activities for the citizens. The Plan will achieve this goal by acquiring, maintaining, and/or preserving a network of parks and trails that provide diverse recreational opportunities for all residents while preserving natural areas and open spaces.

Snohomish County Comprehensive Plan (2015)

The Snohomish County Comprehensive Plan 2035, Park and Recreation Element, contains inventories and an action plan for providing park services through 2035. The Park Element is based upon, and consistent with, policies provided in the General Policy Plan (GPP), Snohomish County Tomorrow Countywide Planning Policies (CPP) and Puget Sound Regional Council Multicounty Planning Policies (MPP).

The GPP, CPP, and MPP represent different layers of geographic consideration and range from planning for the Central Puget Sound Region (King, Kitsap, Pierce, and Snohomish Counties), to Snohomish County boundaries (including cities, towns, and tribal areas), to unincorporated Snohomish County alone.

The Snohomish County Comprehensive Plan outlines the goals of the GMA (RCW 36.70A) that are most closely related to the development of the Park Element:

> Open space and recreation: Retain open space, enhance recreational opportunities, conserve fish and wildlife habitat, increase access to natural resource lands and water, and develop park and recreation facilities.

4.8.5 Shoreline Management Plan/Policy

There is no shoreline management plan or program at the Project because there are no private lands adjacent to the Project Boundary. The Project reservoir shorelines and adjoining uplands are lands managed by NPS.

4.8.6 Designated Scenic and Protected River Segments

In 1978, 158.5 miles in the Skagit River basin were designated as part of the wild and scenic river system (Figure 4.8-41), with 100 miles classified as scenic and 58.5 miles classified as recreational. The Mt. Baker-Snoqualmie National Forest is responsible for the SRMP (USFS 1983). The portion of the Skagit River from Bacon Creek downstream to just east of the town of

Sedro-Woolley is classified as recreational. Three tributaries—the Sauk, Suiattle and Cascade rivers—are classified as scenic. Approximately 50 percent of the river system is in private ownership, primarily in the Skagit and lower Sauk (USFS 2019a). Based on the findings of the Skagit Wild and Scenic River Eligibility and Suitability Study, the NPS has determined that the 11 miles of the Skagit River from RLNRA boundary to Gorge Powerhouse, as well as Goodell Creek and Newhalem Creek, are also eligible as recreational for inclusion in the Skagit System, but as of 2019 this segment is not designated (NPS 2012).

On December 19, 2014, 14.3 miles of Illabot Creek were designated as wild and scenic, with 4.3 miles classified as wild and 10 miles classified as recreational. As with the Skagit System, Mt. Baker-Snoqualmie National Forest is the managing agency for the Illabot Creek Wild and Scenic River. Approximately 2.1 river miles of this wild and scenic river crosses through the City Light-owned Illabot South wildlife mitigation property.

The Skagit, Sauk, Suiattle, and Cascade rivers are Washington rivers of statewide significance under Chapter 173-18 of the WAC, wherein a river of statewide significance is defined as a river west of the Cascade Mountains with a mean annual flow of 1,000 cubic feet per second or more. However, none of these rivers, nor Illabot Creek, have been included to date in the Washington State Scenic River System per the RCW Chapter 79.72.

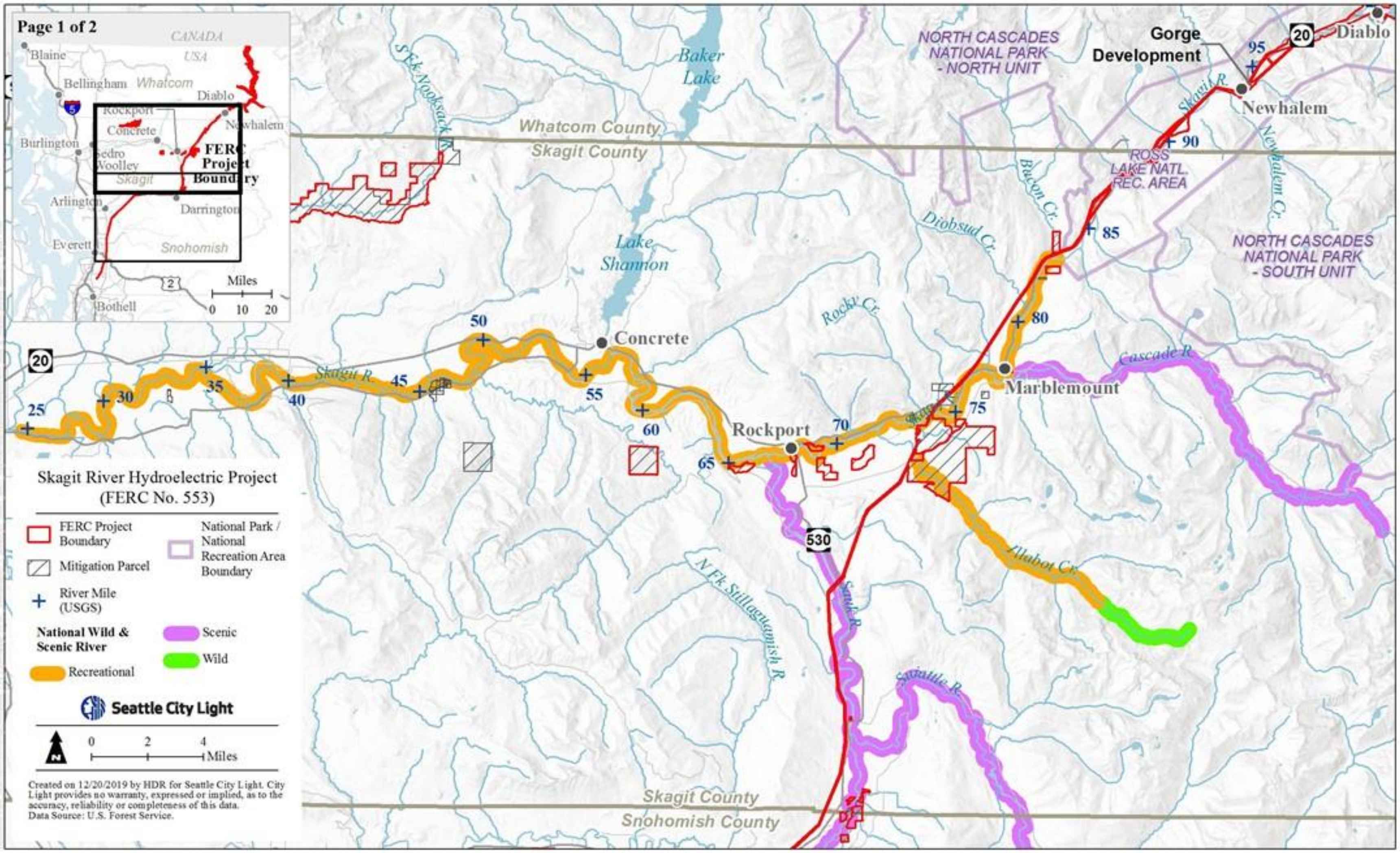


Figure 4.8-41. Wild and Scenic River designations in the Project vicinity (page 1 of 2).

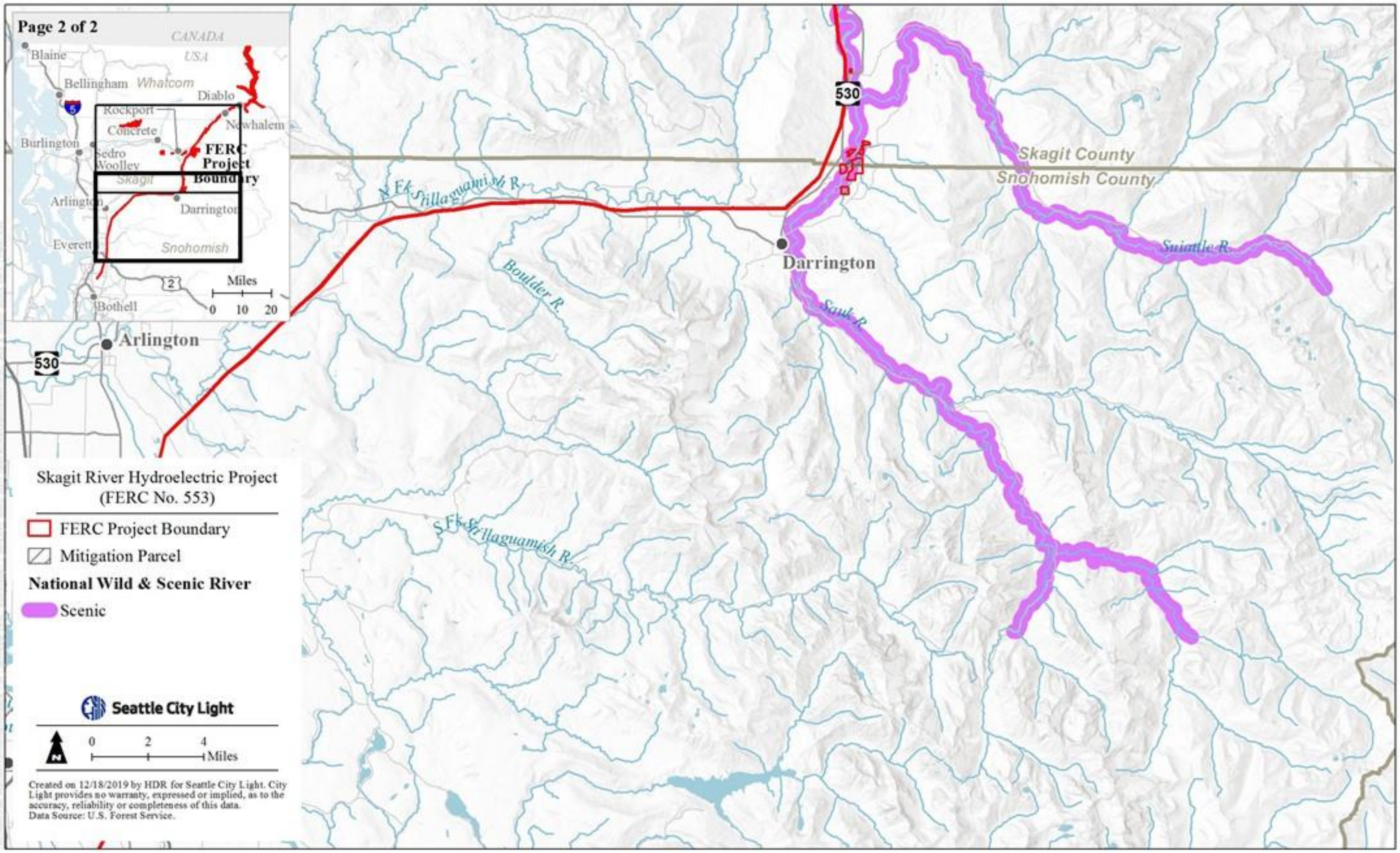


Figure 4.8-41. Wild and Scenic River designations in the Project vicinity (page 2 of 2).

4.8.7 National Trails System and Wilderness Area Lands

The National Trails System Act of 1968 called "for establishing trails in both urban and rural settings for people of all ages, interests, skills, and physical abilities. The act promotes the enjoyment and appreciation of trails while encouraging greater public access. It establishes four classes of trails: national scenic trails, national historic trails, national recreation trails, and side and connecting trails" (NPS 2019j).

The PNT is the only scenic trail that intersects the Project Boundary (Figure 4.8-42). The PNT joins the East Bank Trail near the mouth of Devil's Creek on Ross Lake and follows the lake's east shore to Ross Dam, where it proceeds up the west shore of Ross Lake to Big Beaver Creek. In total, a 60-mile segment of the PNT passes through North Cascades National Park and RLNRA. The PNT begins at the Continental Divide in Glacier National Park and travels over 1,200 miles through Montana, Idaho, and Washington before reaching the Pacific Ocean near Cape Alava. In 2009, Congress designated the PNT as a National Scenic Trail, granting administrative responsibility to USFS. The PNT passes through seven National Forests, three National Parks, one BLM resource area, lands managed by the Washington DNR, Idaho Department of Lands, Washington State Parks, Idaho State Parks, and small sections of private land (USFS 2018).

While it does not intersect the Project Boundary, another national scenic trail—the Pacific Crest Trail (PCT)—crosses SR 20 approximately 20 miles east of the Project at Rainy Pass (Figure 4.8-42). The PCT is one of the original National Scenic Trails established by Congress in the 1968 National Trails System Act. It begins at the Mexico-California border and is a total distance of 2,650 miles through California, Oregon, and Washington, ending at the U.S.-Canada border (USFS 2019b). In addition to being split into regions (Southern, Central, Northern California, Oregon and Washington), the trail is divided into "Sections," with Section L being near the Project vicinity (PCTA 2019). Section L starts at the Rainy Pass Trailhead near Stehekin, Washington, in the Okanogan-Wenatchee National Forest and goes north for 66.7 miles and 13,244 feet of cumulative elevation gain to Manning Park, BC (AllTrails 2019).

The National Wilderness Preservation System provides federal-level protection for preservation of wilderness areas in their natural condition. There are no federally designated wilderness areas located within the Project Boundary (Figure 4.8-42); however, the federally designated Stephen Mather Wilderness is located on North Cascades National Park Service Complex lands surrounding and adjacent to the Project (NPS 2019i). The Stephen Mather Wilderness includes portions of the North Cascades National Park, RLNRA, and the Lake Chelan National Recreation Area (Wilderness Connect 2019a). Public law 100-688 that created the wilderness area preserved FERC's jurisdiction over the nearby hydroelectric projects. The Stephen Mather Wilderness has a total of 638,173 acres located entirely in Washington State and managed by NPS. Within RLNRA, over 80,000 acres are designated wilderness. Over 5,000 additional acres within RLNRA in the Big Beaver (1,554 acres) and Thunder Creek (3,559 acres) have been designated as potential wilderness. The Stephen Mather Wilderness is bordered by the Pasayten Wilderness to the northeast, the Mount Baker Wilderness to the northwest, the Noisy-Diobsud Wilderness to the west, the Glacier Peak Wilderness to the south, and the Lake Chelan-Sawtooth Wilderness to the southeast.

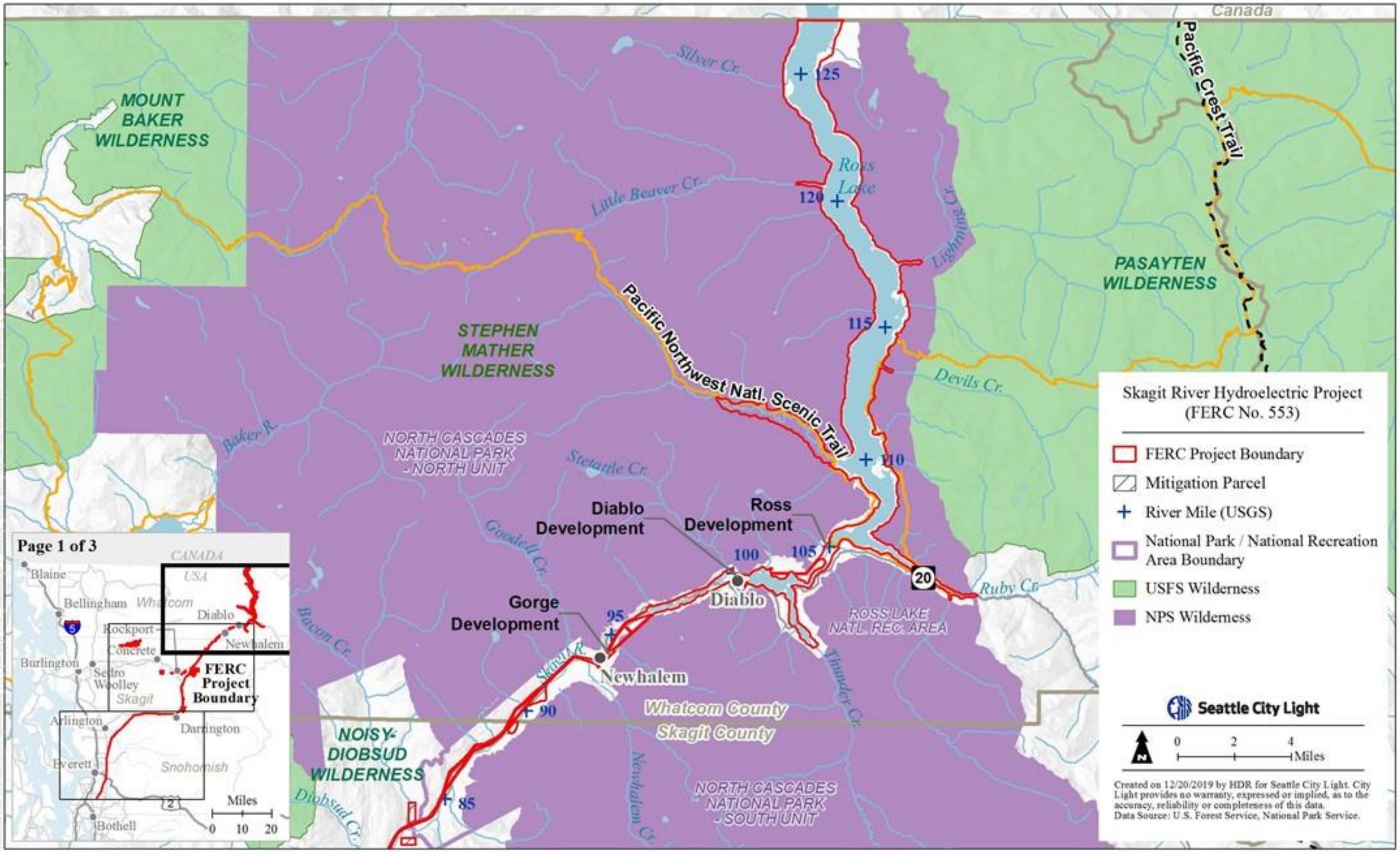


Figure 4.8-42. National Scenic Trails and Wilderness Areas in the Project vicinity (page 1 of 3).

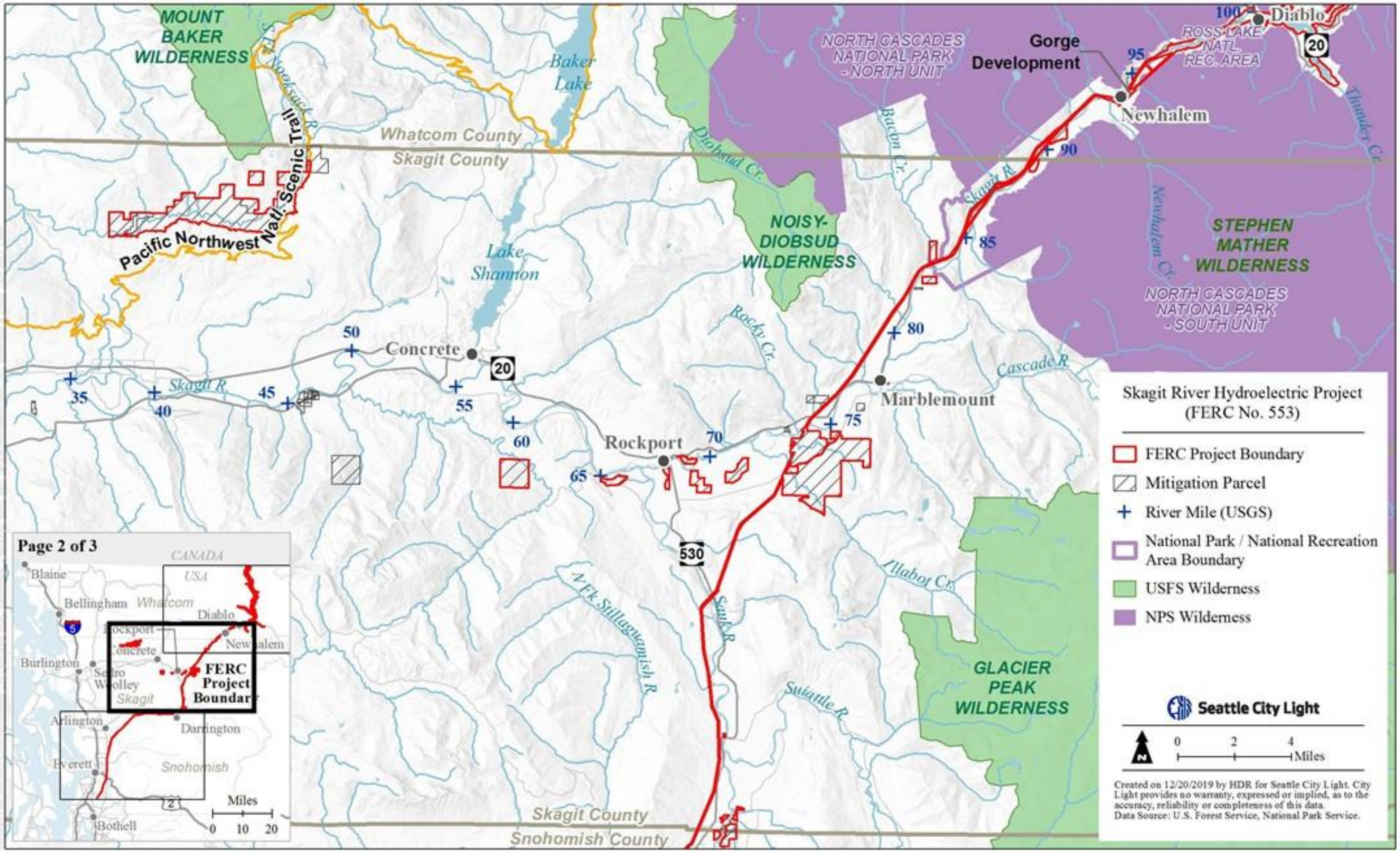


Figure 4.8-42. National Scenic Trails and Wilderness Areas in the Project vicinity (page 2 of 3).

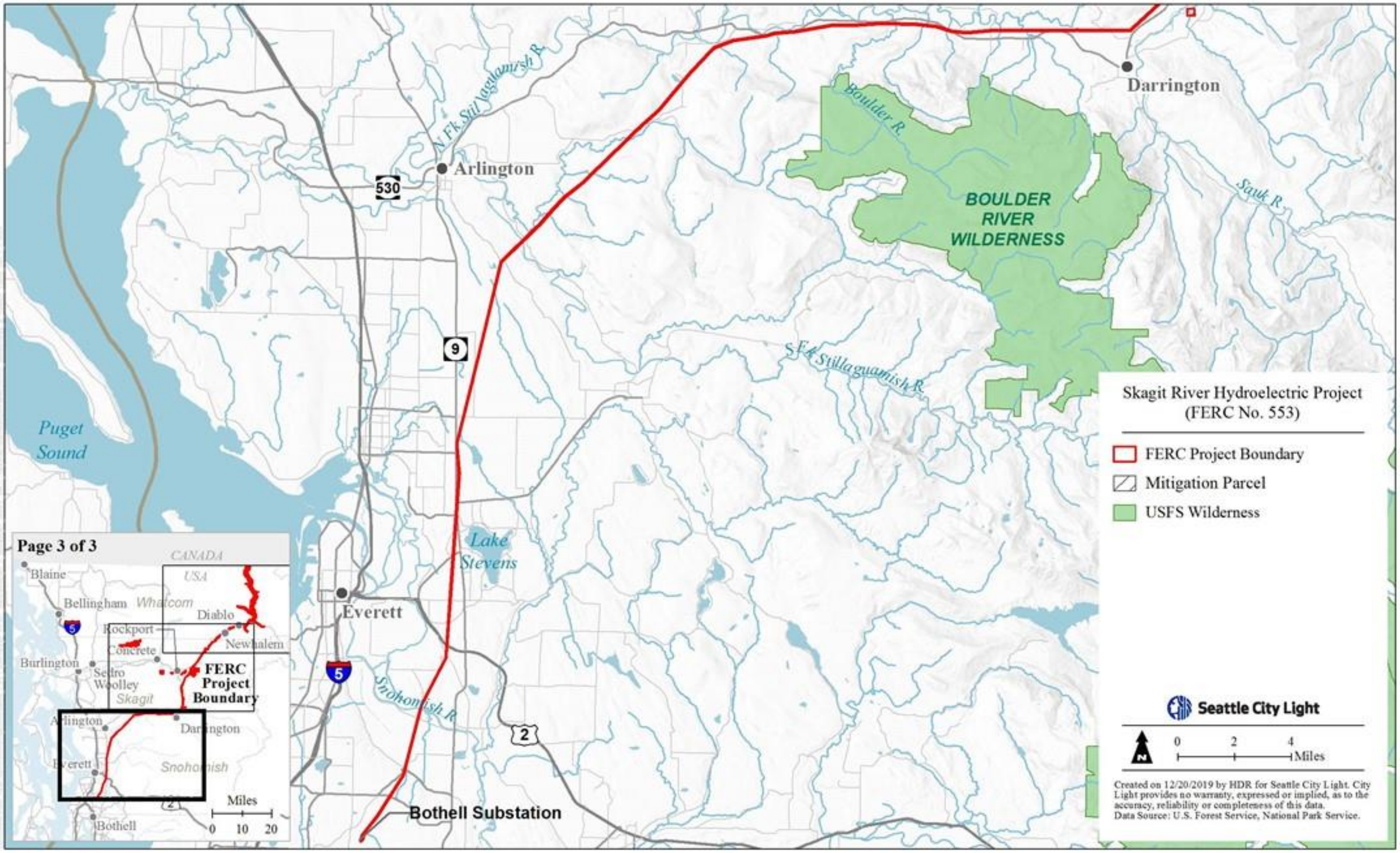


Figure 4.8-42. National Scenic Trails and Wilderness Areas in the Project vicinity (page 3 of 3).

4.8.8 Regional Recreation Areas

Regionally, the Project is located in northwest Washington and south central British Columbia, which is largely natural, remote, and rural area, with abundant opportunities for water-based and backcountry recreation. Recreation facilities and opportunities are identified within the Project vicinity generally defined as the watershed of the Skagit River, northerly from headwaters in British Columbia southerly to Rockport in Washington (Figure 4.8-43). The recreation opportunities and facilities within the Skagit River watershed include camping, backpacking, day use, swimming, hiking, rafting, kayaking, climbing, and horseback riding. Regional areas are described below by locality. In addition to the U.S. and Canadian recreation areas described below, there are innumerable state and locally managed parks, campgrounds, and access areas.

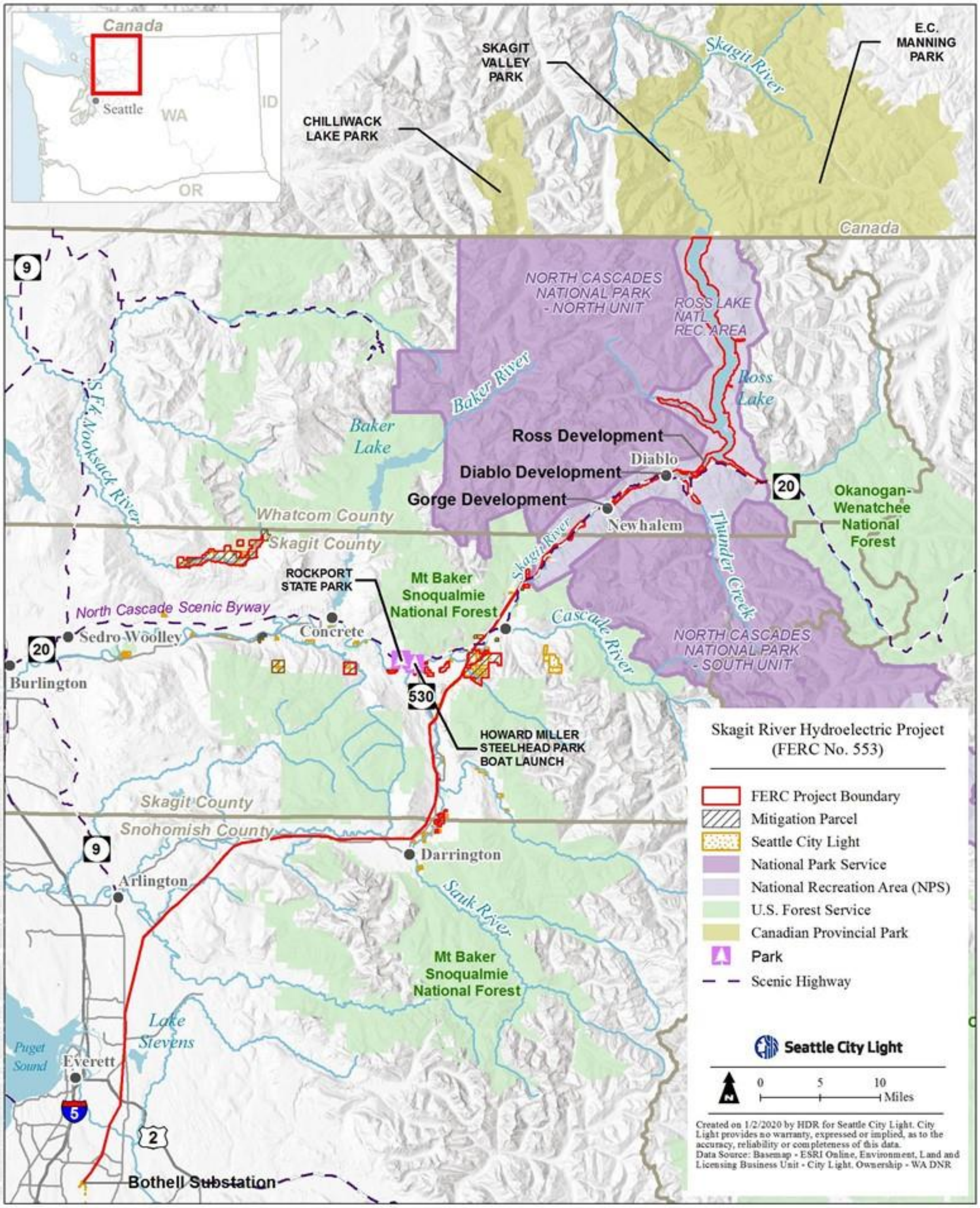


Figure 4.8-43. Regional recreation opportunities in the Project vicinity.

4.8.8.1 U.S. Recreation Areas and Byways

Ross Lake National Recreation Area

RLNRA is part of the North Cascades National Park Complex, which also includes North Cascades National Park and Lake Chelan National Recreation Area, and encompasses approximately 117,000 acres. RLNRA was created to provide for public outdoor recreation use and enjoyment of portions of the Skagit River and Ross, Diablo, and Gorge lakes. The Project reservoirs and hydropower facilities are within the RNLRA, as described in Section 4.8.1.

North Cascades National Park

North Cascades National Park, established in 1968, is part of the North Cascades National Park Complex, and encompasses approximately 500,000 acres to the west and north of RLNRA. The North Cascades Visitor Center is adjacent to the Newhalem Creek Campground and is open May – September in most years. The Stephen Mather Wilderness includes most of North Cascades National Park and RLNRA.

Mt. Baker-Snoqualmie National Forest

The Mt. Baker-Snoqualmie National Forest encompasses over 1.7 million acres in northwestern Washington, extending nearly 140 miles between Seattle, Washington, and Vancouver, British Columbia. The Mt. Baker-Snoqualmie National Forest offers many developed recreation facilities, as well as opportunities for dispersed recreation, such as hiking, hunting, camping, picnicking, and fishing. The Mt. Baker-Snoqualmie National Forest also administers the Skagit River Wild and Scenic System. Mt. Baker-Snoqualmie National Forest manages the Marblemount Boat Launch which is located downstream of RLNRA on the Skagit River section of the Wild and Scenic system.

Okanogan-Wenatchee National Forest

The Okanogan-Wenatchee National Forest encompasses over four million acres to the east of the RNLRA. The Pasayten Wilderness is largely within Okanogan National Forest.

North Cascades Scenic Byway (SR 20)

The North Cascades Scenic Byway (SR 20), discussed in Section 4.8.1.8 of this PAD, is the northernmost route across the Cascade Mountain Range in Washington. It ascends from the Methow Valley to the craggy peaks of the North Cascades before dropping into the Puget Sound lowlands offering travelers a wide array of beautiful vistas and is part of the Cascade Loop, a 400-mile driving tour through the Cascades (The Cascade Loop Association 2019). SR 20 overlaps portions of the Project Boundary along the transmission lines, along and across Gorge Lake, and across Diablo Lake.

Howard Miller Steelhead Park

Skagit County Parks and Recreation operates Howard Miller Steelhead Park near the confluence of the Skagit and Sauk Rivers in Rockport, Washington. It is located along the Skagit Wild and Scenic River. A number of recreation opportunities are provided at the park, including camping, biking, wildlife viewing, and history. Howard Miller State Park is home to the Skagit River Interpretive Center and Skagit River Bald Eagle Awareness Team, which organizes the annual

Bald Eagle Festival. Howard Miller State Park is also a popular jumping off point for water-based activities on the Skagit Wild and Scenic River, including river rafting and fishing. There is a paved boat launch for trailered vehicles at the park.

Rockport State Park

Rockport State Park, operated by Washington State Parks, is a 632-acre day-use park located on the north side of SR 20 one mile west of Howard Miller Steelhead Park. The park provides restrooms, grills, and picnic tables including one picnic shelter. Activities include bird watching, wildlife viewing, and trails, including one mile of ADA-accessible hiking trail. Camping had previously been available at the park, but due to hazard trees, the campground area has been closed indefinitely. The nearest available camping at a state park is located at Rasar State Park, located approximately 16 miles further west off SR 20.

4.8.8.2 British Columbia Recreation Areas

Three Canadian provincial parks managed by BC Parks provide regional recreation opportunities directly north of RLNRA. Located at the upstream end of Ross Lake and encompassing the headwaters of the Skagit River, Skagit Valley Provincial Park supports activities such as canoeing, cycling, fishing, hiking, horseback riding, hunting and swimming. Facilities available include boat launches, fire rings, potable water, camping, day-use picnic areas, and walk-in/backcountry/wilderness camping (BC Parks 1998). Skagit Valley Provincial Park includes Ross Lake Campground, which is adjacent to Hozomeen (see Section 4.8.1.1 of this PAD). The other provincial parks located directly north of RLNRA are Chilliwack Lake Provincial Park and Manning Provincial Park, which provide similar recreation opportunities and facilities. Together, all three provincial parks encompass approximately 298,000 acres.

4.8.9 Other Land Use and Management

4.8.9.1 Project Lands

The Project Boundary is comprised of the continuous Skagit River Project (for generation and transmission line corridor; 22,105 acres) and non-continuous (Marblemount and Sauk River boat launches, and fish and wildlife mitigation lands; 9,346 acres) for a total of 31,451 acres. Of these lands, the approximate division is 61 percent federal, 32 percent City Light, 5 percent private, 1 percent state, and < 1 percent for county and other city/municipal.

The transmission line corridor is generally 150 to 400 feet wide and runs through forested, agricultural, commercial, and residential land uses. The mitigation lands were purchased for fish and wildlife habitat values and are largely undeveloped.

4.8.9.2 Adjacent Lands

The Project reservoirs and associated generation facilities are within RLNRA. The RNLRA is part of North Cascades National Park Complex, which also includes North Cascades National Park, Lake Chelan National Recreation Area and the Stephen Mather Wilderness. The Okanogan-Wenatchee National Forest abuts RLNRA in the vicinity of Ross Lake and includes the Pasayten Wilderness. These vast expanses of federal land are managed for public recreational use, and for resource protection and preservation.

Land uses adjacent to the Skagit River, below Gorge Powerhouse and along the transmission line corridor, consist of commercial, agricultural, and residential land, along with National Forest and National Recreation Area lands (Figure 4.8-44). Land uses adjacent to the fish and wildlife mitigation lands are predominantly forest.

Figure 4.8-44. Project vicinity land use.

4.8.10 Known or Potential Effects

The primary issues related to recreation resources within the Project Boundary are not related to Project effects on resources, but instead are concerned with the Project purpose of providing public access and use of Project lands and waters. This PAD is intended to provide existing relevant available information on recreation resources in the Project and its vicinity to form a basis for analyzing the adequacy of the existing Project recreation opportunities and their consistency with the land management goals and objectives of local, state, and federal agency plans. Section 4.8.11 of this PAD describes measures City Light has taken during the current Project license and proposals to consider for the new license term to ensure appropriate public access and use of the Project. In this sense, the Project's effects on recreation resources are overwhelmingly positive. City Light is a responsible manager and active partner in providing and maintaining recreation opportunities in the Project and its vicinity.

4.8.10.1 Project-Related Effects

Recreation

Project effects on recreation resources vary by Project development and by activity type. These effects are described below.

Ross Lake

Changes in water surface elevations at Ross Lake affect recreation access and experience. Accessibility to floating docks, boat ramps, and boat access camps varies with Ross Lake water surface elevations (Table 4.8-1). To balance recreation interests with other Project purposes, the current Project license requires City Light to achieve Ross Lake normal maximum water surface elevation of 1,602.5 feet by July 31 annually. City Light strives to maintain maximum water surface elevation July 1 through Labor Day to coincide with summer recreation use. As the summer season progresses, the lake may fluctuate a few feet for power generation and to meet instream flow needs in the Skagit River downstream of the Project. In the winter months, Ross Lake can be as much as 127 feet below maximum water surface elevation for flood control purposes. Recreational use of the reservoir in the winter, however, is limited by access restrictions and weather conditions.

Diablo Lake

Changes in water surface elevations at Diablo Lake for Project construction and maintenance activities that affect recreation access and experience are relatively infrequent. Diablo Lake typically fluctuates four to five feet daily; boat launches and docks remain usable under these conditions. Drawdowns of 10-12 feet occur occasionally as needed for Project construction or maintenance, resulting in lake levels too low to accommodate boat access to Colonial Creek boat launch and dock.

City Light, NPS, and Ross Lake Resort use a tugboat and barge to shuttle equipment and vehicles across Diablo Lake to Ross Powerhouse several times per week and to Ross Dam for O&M. There are also multiple daily powerboat trips to shuttle crews to and from the Ross Development. City Light boats slow down to minimize wake impacts on kayakers and canoeists. However, noise from the City Light boat operations has the potential to impact visitor experience on Diablo Lake and the Diablo Lake Trail and at the ELC.

Over the course of the next license period, large-scale maintenance/upgrade projects may occur (Section 3.7.2) which have the potential to effect recreation resources. The road from SR20 to the Diablo Boathouse will need major maintenance work, including significant repair or replacement of the timber crib wall on the section between the highway and Diablo Dam. Similarly, the Diablo Dam spillway bridge may need significant repairs. This work has the potential to limit or temporarily close public access to the Skagit Tour Dock, ferry dock, Diablo Lake Trailhead, and ELC if portions of the road need to be closed during the work. These potential effects can be mitigated by scheduling the work to occur outside of the primary recreation season and/or implementing a traffic control plan which attempts to provide some level of safe public access along the road even when construction is going on.

Gorge Lake

Changes in water surface elevations at Gorge Lake for Project construction and maintenance affect recreation access and experience. Gorge Lake typically fluctuates three to five feet under normal operations; the one boat launch and dock remains usable by boaters under these conditions. Drawdowns of up to 50 feet occur occasionally as needed for Project inspection or maintenance, resulting in lake levels too low to accommodate motorized boat access to the Gorge Lake boat launch and dock. However, motorized boat use of Gorge Lake is relatively low and it is still possible to launch paddle craft from the shoreline.

The town of Diablo and the Diablo Powerhouse and switchyard are at the upper end of Gorge Lake. Maintenance activities in both these locations can involve the use of heavy equipment and vehicle with potential noise and traffic impacts on the visitor experience at Gorge Campground and/or the two trails that start from this area.

Gorge Bypass Reach

Gorge Dam diverts water to Gorge Powerhouse downstream, bypassing 2.5 miles of the Skagit River. Project operations at the Gorge Development affect flows in the Gorge bypass reach, resulting in potential effects to recreation use of the Gorge bypass for whitewater boating and angling use. Under the current and previous licenses, public access is restricted in the bypass reach for safety. Flows in the bypass reach are limited to accretion flow, spill-gate seepage, intermittent tributary input, and precipitation runoff, except when water is being spilled at Gorge Dam. Spill occurs on an annual basis during maintenance outages as well as when inflow to Gorge Lake exceeds the generation capacity.

Downstream of Newhalem

Flows in the mainstem Skagit River downstream of Gorge Powerhouse are determined by the current Project license which fully incorporated the measures included in the FSA Flow Plan (City Light 1991). The primary purpose of the Flow Plan is to minimize the effects of Project operations on salmon and steelhead. The Flow Plan also established a FCC, which consists of representatives from the tribes and WDFW, to address and approve any deviations from the planned flow measures needed to respond to changing conditions (e.g., flow insufficiency or flood flows). Management of flows under the Flow Plan does generally not affect usability of river access sites and the fishability of the river downstream of the Project.

Land Use

The Project's operation does not affect land uses in the vicinity of the Project.

4.8.10.2 Cumulative Effects

The direct effects of the Project (i.e., fluctuating water levels and flows) combined with activities and actions by others may result in cumulative effects to recreation. Water withdrawals, revisions to the FSA Flow Plan or other directives for river flows, and climate change have the potential to affect Skagit River flows and Project reservoir levels.

Occasional maintenance projects in and around the townsites can result in higher than normal noise and traffic. This area, however, has higher than ambient noise levels, particularly in the summer, due to traffic volume on SR 20 and visitor use in Newhalem. Noise impacts in this are likely more obvious to off-season visitors, but visitation is very low between the months of November and March, when SR 20 is closed. During these months, however, the noon whistle and noise from maintenance-related projects and use of the helipad in Newhalem are likely to be more obvious to visitors. The helipad is used two days per month for snow surveys between the end of December and early May and more often if SR 20 is closed between Newhalem and Gorge. Helicopter activity is also associated with firefighting and other specific projects year round.

Noise generated by NPS, Ross Lake Resort, visitors to the Project and surrounding areas, and vehicles traveling on SR 20 also are potential cumulative sources of noise effects.

4.8.11 Existing or Proposed Protection, Mitigation, and Enhancement Measures

4.8.11.1 Existing Measures

The 1995 Project license includes multiple measures to support recreational, educational, and interpretive facilities and services within the Project Boundary and on the surrounding federal lands. The Recreation and Aesthetics Settlement Agreement (1991) provides the structure for City Light's recreation program both within the Project Boundary, on surrounding federal lands, and along the Skagit River Wild and Scenic River System downstream of the Project. The settlement agreement includes requirements for City Light to provide funds to NPS to construct and maintain facilities in RLNRA, and to USFS to construct and maintain facilities along the Skagit River Wild and Scenic River and the SR 20 corridor.

PME measures under the current Project license take one of three forms. City Light has direct responsibility for Project operational measures related to recreation, and certain recreation facilities and programs. City Light also provided funding to NPS and USFS for major one-time capital projects and improvements. Lastly, City Light works with NPS, USFS, and NCI to support their facilities and services in the Project vicinity on an annual basis.

City Light's Direct Recreation Responsibilities

Under the current license, the Project is operated to achieve Ross Lake water surface elevation of 1,602.5 feet by July 31 annually. City Light strives to maintain water surface elevations near this level from July 1 through Labor Day to coincide with summer recreation use. This PME measure is provided in balance with generation and other Project purposes. Ross Lake water elevations are available in real-time on the USGS website.

City Light constructed the North Cascades ELC and provides support for a long-term operating budget through an endowment. City Light continues to supply electricity and ongoing funding for vehicles, major building maintenance, and wildlife education. City Light owns the facility and leases it for $1 per year to NCI, a non-profit organization focused on environmental education. NCI develops and provides educational programming and is responsible for day-to-day operations.

City Light's other direct recreation responsibilities under the current Project license are:

- Provide ferry service on Diablo Lake.
- Construct and operate the Skagit Information Center.
- Construct expanded restrooms, parking, and interpretive signs at Newhalem townsite.
- Maintain Ladder Creek Falls and Garden and Trail of the Cedars.
- Provide tours to the public (Skagit Tours are currently done in collaboration with NPS and NCI, with all funding and the boat provided by City Light).

One-time Capital Projects and Improvements

Funding from the license has been used to support the following recreation-related capital projects for NPS, USFS, and other recreation providers in the Project vicinity:

- An assessment of bicycle facilities needed along the SR 20 corridor between Newhalem and Diablo.
- Improvements to boat launches at Hozomeen, Colonial Creek Campground, Gorge Lake Campground, Goodell Creek, and Copper Creek.
- Modifications to or replacement of floating docks for six boat-in campsites on Ross Lake and improvements at the Desolation Peak trailhead/dock.
- Construction of an accessible fishing pier and upgrade the campground at Colonial Creek.
- Improvements to the Hozomeen Campground water supply, realignment of the road to Hozomeen, and construction of a lakeshore trail.
- Development of Gorge Creek Overlook facilities.
- Realignment of the Happy Creek Trail, improvements to trailhead of the Panther Creek Trail, and construction of the Thunder Knob and Hozomeen Lakeshore trails.
- Development of boat launches on the Skagit and Sauk River wild and scenic segments.
- Development of a boat launch at Copper Creek.
- Improvements to WDFW boat launches in the Skagit River Wild and Scenic River System.
- Improvements to Howard Miller Steelhead Park on the Skagit Wild and Scenic River.
- Development of an ADA-accessible trail at Rockport State Park.
- Installation of picnic tables and restroom facilities at the Damnation Creek picnic site on Skagit River.
- Improvements to recreation sites along the Sauk River south of Darrington, including the Old Sauk ADA-accessible trail and Bedal Campground and boat launch improvements.

- Design and installation of interpretive and way-finding signs within RLNRA and along the Skagit River Wild and Scenic River corridor and the North Cascades Scenic Byway.

On-going Annual Partner Support

Under the current license City Light provides funding to support the following recreation management activities performed by others:

- USFS management and maintenance at the Marblemount and Sauk River boat launches (USFS).
- USFS maintenance of WDFW boat launches along the Skagit and Sauk rivers.
- NPS O&M of recreational facilities in RLNRA, including the boat-in campgrounds along Ross and Diablo lakes.
- USFS O&M of recreational facilities along the Skagit River Wild and Scenic River corridor and the North Cascades Scenic Byway (SR 20) to Washington Pass.
- Periodic needs assessments by the NPS and associated construction of identified capital facilities for recreation in RLNRA.
- Periodic needs assessments by the USFS associated construction of identified capital recreation facilities in the Skagit River Wild and Scenic River corridor and along the North Cascades Scenic Byway (SR 20) between the border of RLNRA and Washington Pass.

4.8.11.2 Proposed Measures

No new PME measures for recreation resources and land use are proposed at this time. PME measures will be developed following completion of studies in the relicensing process. City Light anticipates that its recreation plan will include continuation of the operation of Skagit tours, ferry services, the ELC, and Skagit Information Center, and maintenance of Ladder Creek Falls and Trail of the Cedars.

4.9 Aesthetic Resources

This section describes the existing visual characteristics of the Project vicinity, defined as the Project structures and reservoirs, transmission line ROW from the powerhouses to Bothell Substation, Gorge bypass reach, Marblemount and Sauk River boat launches, and fish and wildlife mitigation lands in the Skagit, Sauk, and South Fork Nooksack watersheds. This section also describes land management plans relevant to visual resources.

The northern portion of the Project Boundary, which includes the generating facilities, is characterized by steep, forested mountains and valleys, with the Skagit River and three reservoirs in the foreground and snowcapped peaks and glaciers in the background. South of Newhalem, the Project components include only the transmission line corridor, non-continuous recreation sites (i.e., the Marblemount and Sauk River boat access sites), and fish and wildlife mitigation lands. Within this portion of the Project Boundary the transmission line descends in elevation and traverses south as the Skagit River Valley first narrows, constricting views and then widens near Marblemount. At this point the landscape transitions from the primitive, natural environment of RLNRA to a more pastoral, rural setting. The transmission line corridor then turns south toward Darrington, crossing forested hills and traveling through the forested Sauk River Valley adjacent to the river. From Darrington to Oso the transmission line travels westward along SR 530 crossing agricultural lands and forested foothills. At Oso the transmission line turns south again, traveling through forested hills before reaching more concentrated suburban towns of Arlington, Marysville, West Lake Stevens, Fobes Hill, and Mill Creek.

The fish and wildlife mitigation lands are located both within and outside of the Project Boundary along the Skagit, Sauk, and South Fork Nooksack watersheds, as well as along tributary streams to the Skagit. The fish and wildlife mitigation lands range from upland areas, to sloughs, ponds, and river shoreline.

This section relies primarily on the following existing sources developed during the previous relicensing period: The Visual Resources Analysis included in the "Response to a Request for Supplemental Environmental Information" (1989 Visual Resources Analysis) prepared by City Light and Envirosphere in 1989; the "Report on Aesthetics: Visual Quality Mitigation Analysis" (Visual Quality Mitigation Analysis) prepared by City Light in 1991; and the Visual Quality Mitigation Plan, included as Part 4 of the Settlement Agreement on Recreation and Aesthetics (Settlement Agreement), which was signed in 1991 (Envirosphere 1989; City Light 1991a, 1991b). This section also utilizes a visual quality assessment prepared by Parametrix in 1989 for Ross Lake, which evaluated the effect of drawdown conditions on the visual quality of the reservoir (Parametrix 1989). Also relevant to this section is the Transmission ROW Vegetation Management Plan prepared in 1990 which outlines vegetation management practices applicable to the transmission line corridor. Additionally, the plan identifies general prescriptions that apply to the entire transmission ROW, and seven specific "Aesthetic Target Areas" located along SR 20 between Bacon Creek and Ross Dam which were prioritized for vegetation mitigation plantings to minimize the visual impact of vegetation management practices in these specific areas (City Light 1990).

4.9.1 Existing Aesthetic Resource Conditions

This section uses existing visual resources assessments, updated maps and aerial imagery, and relevant land management plans to describe the existing visual setting within the Project vicinity. Key terms used to describe the visual setting are defined below.

4.9.1.1 Aesthetic Resource Terminology

The terms defined below are commonly used in the assessment of aesthetic effects. The definitions come from the 1989 Visual Resources Analysis, the NPS Visual Resource Inventory, the NPS Night Skies Program, and the BLM Visual Resource Management System (Envirosphere 1989; BLM 1984; NPS 2019a; Sullivan and Meyer Undated).

- **Visual Quality:** The overall visual impression or attractiveness of an area as determined by the particular landscape characteristics, including landforms, rock forms, water features, and vegetation patterns. The attributes of line, form, and color combine in various ways to create landscape characteristics whose variety, vividness, coherence, uniqueness, harmony, and pattern contribute to the overall visual quality of an area.
- **Contrast:** The opposition or unlikeness of different forms, lines, colors, or textures in a landscape. The contrast can be measured by comparing a project's features with the major features in the existing landscape.

- **Duration of View:** The overall time during which a viewer may experience a given view or scenic vista, depending on the type of activities and uses in an area.
- **Vividness:** The memorability of landscape components as they combine in striking and distinctive visual patterns.
- **Intactness:** The visual integrity of the natural and built landscape, and its freedom from encroaching elements.
- **Unity:** The visual coherence and compositional harmony of the landscape considered as a whole.
- **Viewer Response:** The overall response of a viewer to the appearance of a particular view or project. Viewer response is a function of viewer sensitivity and viewer exposure.
- **Viewer Sensitivity:** The sensitivity of a viewer to changes in visual quality. Viewer sensitivity is affected by variables such as viewer activity and viewer awareness and expectation. Viewer activity affects visual perception by enhancing or diminishing visual acuity. Viewer awareness and expectation inform viewer sensitivity as viewers generally have a reason for looking at the landscape and what they notice is conditioned by what they are looking for.
- **Viewer Exposure:** The extent to which certain viewing conditions (such as the landscape visibility, viewing distance, viewing angle, extent of visibility, and duration of view) affect viewing conditions for a viewer.
- **Light Pollution:** The introduction of artificial light, either directly or indirectly, into the natural environment.
- **Lighting:** For purposes of this analysis, lighting is defined as artificial light used to alter or illuminate the existing nighttime light setting.

4.9.1.2 Setting for Project Aesthetic Resources

Because of the extent of the Project vicinity and the diverse landscapes it traverses, the geographic area considered in this aesthetic resources conditions description was delineated into seven discrete landscape units (or "zones") along the Skagit and Sauk rivers.[38] The visual setting of each of these units is described in greater detail below, as is the nighttime sky setting of the Project vicinity. As described in further detail in sections 4.9.1 and 4.9.2, below, the Project generating facilities are located between Ross Lake and Newhalem. In this area, Project facilities are prominently visible from some publicly accessible viewpoints and are less visible from others. Below Newhalem, the Project Boundary includes fish and wildlife mitigation lands and the transmission line corridor. The visibility of the transmission line corridor varies as it travels from Newhalem to Bothell. In areas where the transmission line corridor crosses SR 20, SR 530, SR 9 or the Skagit, Sauk, South Fork Stillaguamish, and Snohomish rivers, or is located near communities, it is highly visible for potential viewers. In locations where the transmission line corridor crosses more remote, or inaccessible terrain, the transmission line corridor is less visible. Therefore, below the town of

[38] Zones 1 through 5 were created in the 1989 Visual Resources Analysis. Zones 6 and 7 were created in this document to describe the visual resources of the transmission line from Darrington to Bothell and of the fish and wildlife mitigation lands which were not included in the 1989 Visual Resources Analysis.

Newhalem, the visibility of Project facilities is limited to the transmission line corridor and viewing locations near the corridor.

Zone 1: Ross Lake Zone

Ross Lake is 24 miles long, stretching from Ross Dam into Canada. At the south end of Ross Lake, SR 20 turns southeast, runs parallel to the Ruby Arm of Ross Lake for approximately five miles and then continues south, away from the Project. As a result, access to Ross Lake is limited to pedestrian access along the Ross Dam Trail, which leads from SR 20 to Ross Dam and the East Bank Trail, which has a trailhead on SR 20 and travels along the east shore of Ross Lake. There are three public boat launches near the recreation site of Hozomeen at the north end of the lake, which are accessible via a 40-mile unpaved road from Hope, British Columbia. The majority of public viewer groups in the Ross Lake area include motorists, anglers, boaters, hikers, and horse riders near the reservoir.

Views of Ross Lake from SR 20 are limited to two designated highway overlooks and a few informal pullouts, all concentrated at the southern end of the lake and along Ruby Arm (Figures 4.9-1 and 4.9-2). Conversely, there are numerous views of the lake available to people using the shoreline trails and campgrounds. Views of the upper face of Ross Dam are limited to visitors to Ross Lake Resort, boaters at the south end of the lake, and hikers on the Ross Dam Trail.

Figure 4.9-1. Views of Ross Lake from one of two designated highway overlooks.

Figure 4.9-2. Views of Ross Lake from the second designated highway overlook.

The Hozomeen/Willow Lake, Desolation, Lightning Creek, Devil's Dome Loop, and Jack Mountain trails climb up the eastern slope of the mountains surrounding Ross Lake from the reservoir shoreline. Views of Ross Lake are available at various points along these trails. Along the west shore of the reservoir, the Big and Little Beaver trails run through canyons leading away from the water but views of Ross Lake are available along portions of these trails. The Sourdough Mountain/Pierce Creek trails connect Ross Lake to the town of Diablo and ascend Pierce and Sourdough mountains, providing views of Ross and Diablo lakes. Backcountry camps in the wilderness that have views of Ross Lake include the Pierce Mountain Camp near Sourdough Lookout, Desolation Camp, and Jack Mountain Camp (Envirosphere 1989; Parametrix 1989).

Located on the southwestern shore of the reservoir, Ross Lake Resort has existed since the 1950s and is the only developed lodging facility on the reservoir. The resort includes twelve individual cabins and three bunkhouses on docks built over log floats arranged in a line along the shore of the reservoir; a boat rental facility includes a dock lined with boats and a fueling station. The cabins and the rental facility are constructed of wood-shake siding, white-trimmed windows, and metal roofs. The docks extend a few feet beyond the footprints of the cabins, creating a linear porch in front of the cabins, which is lined with wooden Adirondack chairs and planters. Although the resort introduces an element of contrast along the otherwise undeveloped shoreline, the cabins themselves have a simple, unified, rustic aesthetic appearance. The resort is popular among boaters and anglers.

Ross Lake is located in a deep valley in the Cascade Mountains and the surrounding mountains are rugged. Steep-forested slopes rise to alpine meadows, glaciers, and rocky peaks. Views from the reservoir are expansive and, due to the lack of development along the reservoir, give the viewer the sense of being in a wilderness area (Envirosphere 1989; Figure 4.9-3). The reservoir is a scenic attraction and visual focal point for viewers along SR 20 and recreationalists in RLNRA, especially boaters, hikers on the East Bank Trail, and campers at the shoreline camp sites. The broad expanse of the reservoir guides the viewer's gaze to the shoreline, forested slopes, and distant peaks.

Figure 4.9-3. Views from Ross Lake looking north.

During the summer months, the high reservoir levels provide visual continuity between Ross Lake and the surrounding landscape as the shoreline meets vegetated slopes. During the spring, fall, and winter, lower reservoir levels expose large expanses of unvegetated shoreline, which increases the contrast between the lake and the surrounding environment. SR 20 is closed in the winter generally, from late November through April, from MP 135 to 177 (WSDOT 2019). Therefore, very few viewers are present to see winter drawdown conditions of Ross Lake. A small number of hikers, snowshoers, snowmobilers, or skiers may have views of Ross Lake during winter months.

Zone 2: Skagit River Project Facility Zone

This area stretches from Ross Dam to Newhalem and contains most of the Project facilities. Major visual features in this zone include the south portion of Ross Lake near the Project facilities, Diablo Lake, Diablo townsite, Gorge Lake, the dams, powerhouses, and the Newhalem townsite. The transmission lines are a prominent feature of Zone 2, running from Ross Powerhouse to Diablo Switchyard and then to Newhalem.

User groups in this area include motorists and cyclists along SR 20, boaters and campers on the reservoirs, visitors touring the hydroelectric facilities, day and overnight visitors to the ELC, and hikers along the shore and on mountain trails (Envirosphere 1989). Zone 2 provides public views of the frontcountry of RLNRA as seen from SR 20 to views of the wilderness backcountry of North Cascades National Park. Views include steep, forested mountains in the foreground and distant glacial peaks in the background.

City Light adheres to the visual standards for the facilities included in this zone as outlined in the HRMMP (City Light 1991c), Visual Compatibility Guidelines for the Newhalem Historic Area: Historic Landscape Resource Management (NPS 1994), and the Transmission ROW Vegetation Management Plan (City Light 1990). The Transmission ROW Vegetation Management Plan identified seven Target Areas in the Project Boundary for treatment to reduce the visual impacts of the transmission line ROW. There are three Target Areas in Zone 2; these include the viewsheds from Diablo Overlook, the Diablo Y (where SR 20 crosses the northeastern end of Gorge Lake), and the Gorge Dam Viewpoint (near the southwestern end of Gorge Lake). The plan provides vegetation mitigation prescriptions such as plantings and modified pruning to screen views of the transmission lines from these sites while maintaining vegetation management requirements (City Light 1990).

Diablo Lake is surrounded by steep, forested slopes and rock outcrops, and has a dramatic turquoise color during the summer from suspended glacial sediment. SR 20 crosses Thunder Arm near Colonial Creek Campground and gains elevation as it travels along the eastern side of Thunder Arm. Views of Diablo Lake from SR 20 in the foreground and rugged, snow-covered mountain peaks in the distance. Some Project infrastructure, such as the transmission lines from Ross Powerhouse and marine facilities (docks, boathouse, etc.) on the north shoreline of the lake, are visible from SR 20, including from the overlook (Figure 4.9-4). Diablo Dam can be viewed intermittently from SR 20. The Ross facilities are not generally prominent from SR 20 from any location in Zone 2 (Envirosphere 1989).

Figure 4.9-4. Views south from Diablo Overlook.

Public viewpoints along Diablo Lake include the Diablo Lake Overlook, Colonial Creek Campground, and the ELC. The lake and some Project facilities can also be seen from the Thunder Knob, Diablo Lakeshore, and Sourdough Mountain trails. Project facilities visible from portions of Diablo Lake, including Diablo Dam, the lower face of Ross Dam and Ross Powerhouse, and the transmission lines contrast with the surrounding natural environment due to the straight lines, uniform dark and light gray color, and industrial, utilitarian appearance. The lower face of Ross Dam and Ross Powerhouse are visible by participants of Skagit Tours, which provides public boat tours of Diablo Lake, and by paddle craft that launch at Colonial Creek. There are, however, many portions of the lake that do not have any views of Project facilities.

The ELC is located along the northwestern shore of Diablo Lake and is described in more detail in Section 4.8.1.2 of this PAD. The ELC has a modern architectural design and is constructed of light-colored wood, concrete, and metal. The ELC includes many windows and has an angled roofline. The ELC is nearly invisible from Diablo Lake or SR 20.

Diablo townsite is located at the base of Sourdough Mountain off SR 20 and the northeastern end of Gorge Lake; views of the town from SR 20 are very limited (Figure 4.9-5). Steep walls and rock faces surrounding the townsite restrict views from the town and conceal views of the town from surrounding peaks (Envirosphere 1989). Vegetation within the townsite includes primarily nonnative tree species and turf grass. The townsite is divided into two districts, Reflector Bar and Hollywood. Manmade structures on Reflector Bar include the Diablo Powerhouse, a small group of houses, and a few support structures. Many of the buildings in the Reflector Bar are slated for removal and portions of the area will be restored to natural habitat. Hollywood consists mostly of housing. The buildings and open spaces in the Hollywood district are well maintained. Views of Diablo Dam are not available from the town itself. The Diablo Switchyard, located within the townsite is visible from the townsite, but views of the switchyard from SR 20 are limited. Similarly, the Diablo Powerhouse is visible from the townsite and is intermittently visible from SR 20.

Figure 4.9-5. Diablo townsite.

Gorge Lake is long, narrow, and enclosed between steep valley walls. One campground and paved boat ramp are located at the north end of the reservoir. Because of its limited recreational resources, Gorge Lake is not visited heavily by boaters, anglers, or hikers. SR 20 crosses Gorge Lake at the northeastern end and then roughly follows the northern shore of Gorge Lake until Gorge Dam. The lake can be seen intermittently from SR 20. The transmission lines from Diablo Switchyard to Newhalem run parallel to SR 20, crossing the road several times along the lake. The visibility of Gorge Dam from SR 20 is limited except from an informal pullout at MP 123. Partially obstructed views of Gorge Lake and Gorge Dam are available from the Gorge Overlook Trail (Tripadvisor 2019; Outdoor Project 2019; NPS 2019b); the lake, but not the dam, can be seen from the Gorge Creek Overlook.

The Gorge bypass reach is located between Gorge Dam and Gorge Powerhouse where water is diverted through an underground tunnel. The 2.5-mile bypass reach is in a relatively narrow canyon and is bordered by SR 20. Views from SR 20 are confined to the riverbed and the steep canyon walls and associated waterfalls. Transmission lines are visible from SR 20 within the bypass reach. The transmission lines cross SR 20 approximately four times within this stretch (Envirosphere 1989). To provide power to operate the Gorge Dam, an electrical distribution line runs from the powerhouse to the dam. This distribution line runs parallel to SR 20 from Newhalem on wood H-frame poles, northeast for approximately one-mile before it moves to the center of the dry river channel where it is suspended from cables anchored to the walls of the gorge for approximately one mile. The distribution line then crosses the south side of the river and follows the old railroad grade and service road to the dam. The distribution line is moderately prominent for travelers along SR 20 and can be viewed at multiple informal pullouts (Envirosphere 1989).

Flows in the bypass reach are limited to accretion flow, spill-gate seepage, intermittent tributary input, and precipitation runoff, except when water is being spilled at Gorge Dam. The visibility of the river channel from the pullouts along SR 20 is medium to high upstream of Gorge Powerhouse, but visibility is reduced as SR 20 climbs towards the dam. Before the construction of the dam, this section of the river featured a succession of rapids, cascades, and pools. During spill, these features are visible. Under baseflow conditions, the river channel is characterized by large, rounded boulders amidst stretches of smaller cobbles; there are numerous scattered shallow pools. Natural landslides have occurred in the bypass reach due to the steep canyon walls.

The bypass reach ends at Gorge Powerhouse in Newhalem. The river downstream of the powerhouse has a free flowing character. The Skagit River is visible from parts of Newhalem and both the Ladder Creek Falls Trail and the Trail of the Cedars. Public access to the river is limited to the Trail of the Cedars trailhead.

Newhalem includes both historic housing and manicured landscaping in the southwestern part of the town as well as functional hydroelectric facilities such as the Gorge Powerhouse, maintenance facilities, and the Gorge Switchyard. Both the powerhouse and the switchyard are visually prominent from SR 20. Other features in the townsite, such as the parking lot for the Ladder Creek Falls Trail, the access road bridge, and the footbridge are also visible from SR 20. Within the Newhalem townsite and south of Newhalem, transmission lines are visually prominent as the transmission lines parallel SR 20. Vegetation in this zone is upland coniferous and includes fir, cedar, and hemlock trees (Envirosphere 1989).

Zone 3: Ross Lake National Recreation Area: West Entry Zone (Newhalem to Bacon Creek)

In contrast to Zone 2, the river valley is broader and includes some areas of floodplain deciduous forest, as well as forested slopes. South of the Newhalem townsite the Skagit River widens and appears to be free flowing. From the river, foreground views are mostly screened by trees; however, views of rock faces and peaks are intermittently available. The transmission lines border SR 20 from the Newhalem townsite to Babcock Creek and are prominent to motorists but are obscured by vegetation and topography from boaters on the river through this area. The Transmission ROW Vegetation Management Plan (City Light 1990) identifies four Target Areas within Zone 3 for specific measures to reduce visual impacts: Bacon Creek, Pinkie’s (SR 20 MP 114.4), Thornton Creek, and Goodell Creek.

From Babcock Creek to Damnation Creek, the valley narrows, and numerous creeks drain into the Skagit River. At some points, the river is alongside and visible from SR 20. In this area, the transmission line ROW separates into two, with one ROW along SR 20 and the other at higher elevations that are visible from the river. The transmission line facilities are prominent from both SR 20 and the river. Just before the RLNRA boundary, the valley narrows again and the river quickens, creating whitewater rapids. The transmission lines are separate in this area, with the lower transmission line crossing SR 20 five times and the river twice, resulting in prominent views of the transmission lines. Because of the Class 2 and Class 3 rapids along the Skagit River south of Newhalem, this area is a popular whitewater rafting area (Methow Rafting 2019). Most visitors to this area are motorists along SR 20 and rafters and anglers along the Skagit River (Envirosphere 1989).

Zone 4: Transmission Line along the Skagit River: Bacon Creek to Rockport

South of Bacon Creek, the valley widens considerably, and the landscape becomes pastoral due to the increasing presence of rural development; there are also a few agricultural fields along the river's edge. The valley floor is flat and the hills are less steep in this region, allowing for extensive views of the valley. Just south of Bacon Creek, the transmission line corridor separates from SR 20 and the river, making the transmission lines less visible. From SR 20, views of open cultivated fields and forested slopes are available. From the river there are views of the valley, foothills, and distant snow-capped ridges. The river meanders more in this zone through a relatively wide floodplain. This area is frequented by anglers and birdwatchers (Envirosphere 1989).

The transmission line corridor passes west of the town of Marblemount and SR 20 and runs through scattered rural residential sites, agricultural fields, and forested slopes. In this area, the ROW clearance is more visible as it passes through forested foothills. North of the river are larger agricultural fields and scattered residences between the river and slopes of the Helen Buttes. South of the river, the ROW crosses through flat, vegetated sloughs. Views from the river in this section are characterized by the wide Skagit River and dense forest in the foreground and forested mountains in the background. The ROW separates from the river and climbs up and around the northwestern side of the base of Illabot Peaks to meet the Sauk River corridor. In this section, the ROW crosses over moderately steep, densely vegetated foothills, and the ROW clearance corridor contrasts with the surrounding forests (Envirosphere 1989).

Zone 5: Transmission Line along the Sauk River

In the Sauk River Valley, views from SR 530 for motorists differ greatly from the views observed by boaters on the Sauk River. The Sauk River Valley is wide where the Sauk River meets the Skagit River, then it becomes narrower where the transmission line corridor drops into the valley and then widens again toward the south. Views of the river and valley slopes from SR 530 are limited in this area due to the density of vegetation along the roadway. The topography in this section is uneven and many side ridges have been clearcut and now support industrial timberlands in various stages of regeneration. The transmission lines are not highly visible from SR 530, except where they cross the highway just north of the Concrete-Sauk Valley Road.

From the river, however, the viewscape is broader and more open, with views of the river in the foreground and side ridges in the mid- and background. For the most part, the transmission lines in the Sauk River Valley are west of and slightly uphill from the river but are visible from the river in many places. Towards the town of Darrington, the transmission lines move farther west and there is a greater distance and more vegetation between the river and the ROW. This portion of the Sauk River is used less by boaters as compared to upriver sections, due to shallow, rocky conditions (Envirosphere 1989).

Zone 6: Darrington to Bothell Substation

From Darrington, the transmission line ROW turns to the west toward the rural community of Oso and is intermittently visible from SR 530, crossing SR 530 once at Little French Creek. From Darrington to Oso, the valley is wide and flat with steep ridges visible to the north and south. North of SR 530 on the outskirts of Oso, a large, light brown, barren mudslide scar from the 2014 Oso Mudslide is visually prominent on the hillside. The valley is characterized by rural, agricultural lands and housing in the foreground and prominent, steep, forested mountains and rocky peaks such as Whitehorse Mountain and Mount Higgins are in the background. At Oso, the ROW heads southwest, away from SR 530 passing through the foothills to the southeast of Arlington where it turns almost directly south, after crossing the South Fork Stillaguamish River. The ROW continues south, crossing SR 9 at Lake Stevens, and US 2 at the Snohomish River, just west of the town of Snohomish. In this area, suburban areas are intermixed with agricultural lands. Suburban development becomes more prominent as the transmission line approaches Bothell Substation.

Zone 7: Fish and Wildlife Mitigation Lands

As described in Section 3.4.10 of this PAD, under the current Project license, City Light owns approximately 10,850 acres of fish and wildlife habitat lands. The mitigation lands include 3.5 miles of the Skagit and Sauk River shorelines, 8.7 miles of the South Fork Nooksack River, and 97 miles of tributary streams in these watersheds. All the mitigation lands are open to the public but use is relatively low. The general visual characteristics of these lands are briefly described below. Details of the mitigation land parcels can be found in Section 4.6 of this PAD.

Skagit River Basin

South of Newhalem, the fish mitigation parcels, Newhalem and County Line Ponds, are along the northwestern side of the Skagit River and are accessible only by foot. NPS provides bird watching guides for these ponds and directions to bird watchers (NPS 2000). The ponds are located in a narrow portion of the Skagit River Valley where the river is bordered by the tall peaks of Trappers Peak and Big Devil Peak which limits views to the valley. The ponds include riparian habitat located within dense vegetation which mostly encloses views.

Further south there are three mitigation parcels near the confluence of Bacon Creek and the Skagit River. The Bacon Creek parcel is on the north side of the Skagit River and SR 20, east of Bacon Creek, on the densely forested north slope of the Skagit River Valley. A portion of the site was previously a quarry; it is now revegetating naturally. South of Bacon Creek the Goodwin and B&W Road 2 parcels are on the south side of the Skagit River and SR 20. These parcels are on flat, densely forested land that begins to slope upward to become the south wall of the Skagit River Valley. These parcels are in a narrow, steep section of the valley, just before it widens and flattens out and becomes interspersed with fields and developments associated with Marblemount. The transmission lines are prominent in this area as the ROW travels along the river near the parcels.

South Marble 40 is located in the densely forested foothills south of Marblemount. The Corkindale parcel is located along the northern edge of the wide valley bottom west of Marblemount. It abuts the transmission line corridor and is about 0.75 mile from the Skagit River. The Bogert and Tam mitigation lands are located across the Skagit River from Illabot North, between SR 20 and the Skagit River. The site includes the riverbank, densely forested areas, as well as some open clearings surrounded by forested areas. The portion of the mitigation land along the shoreline is characterized by larger shrubs and trees. One of the largest areas of contiguous mitigation land is south of Marblemount and primarily east of the transmission line ROW. These parcels are between the Skagit River and the foothills of the Illabot peaks and include Illabot Slough (North and South), and O’Brien Slough. The eastern portion of the Illabot South parcel has expansive views of the Skagit River and densely forested, steep hills on either side of the valley. Illabot Creek, a wide shallow stream flows through the Illabot North parcel and feeds several sloughs. Vegetation in Illabot Slough is a mix of upland hardwoods and conifers. Portions of the Illabot South parcels have been previously clearcut or burned. The transmission line ROW traverses a small portion of the western end of the Illabot North parcel.

Other wildlife mitigation parcels are scattered throughout the Skagit River floodplain near Rockport both east and west of the Sauk River. These include the Johnson parcel and Lucas, Napoleon, and Barnaby sloughs. In this area, the river runs through a broad floodplain and wetlands have developed in old meander channels. These channels have open, still water interspersed with areas of emergent vegetation and shrubs. In most of these parcels, dense forest limits expansive views but adjacent hills and more distant mountains can be seen from a few grassy clearings and wide wetland pools and the river shoreline. Rockport is nearby but is not visible from the mitigation lands nor are any Project facilities, however SR 20 can be seen from some locations.

The McLeod wildlife mitigation land is located west of the confluence of the Sauk River and the Skagit River. This parcel is located between the Skagit River Shoreline and Concrete Sauk Valley Road. The parcel includes an agricultural field as well as forested habitat along the river. Savage Slough, which is both a wildlife and fish mitigation land, is located south of the Skagit River west of the confluence of Finney Creek and the Skagit River. The Savage Slough mitigation parcels are bisected by the South Cascade Highway and Savage Road. Along these roads, views are generally limited by trees and tall vegetation. Day Creek Slough is located further downstream along the Skagit River west of the community of Day Creek on parcels that are a mix of cultivated land and riverbanks.

Sauk River

Five wildlife mitigation parcels including Dan Creek, Everett Creek, North Everett Creek, Sauk Island, and North Sauk are located along the Sauk River north of Darrington to the confluence of the Suiattle River. The parcels are in a wide, flat section of the south portion of the Sauk River with steep forested ridges to the east and west. The river itself is shallow and meanders and splits due to the presence of gravel bars. There are some agricultural fields located to the east of the wildlife mitigation lands and the transmission line corridor is to the west. Along the river, wide, expansive views are available of the Sauk River in the foreground and surrounding ridges in the background.

South Fork Nooksack River

Approximately 4,420 acres of contiguous wildlife mitigation lands are along the South Fork of the Nooksack River, including the Bear Lake, Nooksack, and Nooksack West parcels. The parcels in this area stretch from the shoreline of the Nooksack River up the slopes of the foothills of the Twin Sister Peaks and include a small lake and a large wetland complex. The Nooksack River runs through a narrow, winding valley, which generally limits views. With the exception of Twin Sisters Peak, the mountains adjacent to the Nooksack are not as high as those near the Skagit River. Many of the forested slopes in this region have been clearcut and the timber is in various stages of regeneration. A few portions of the South Fork Nooksack River mitigation lands at higher elevations have expansive views of the river and adjacent forested hills. The transmission line ROW and Project facilities are distant from the Nooksack mitigation parcel and are not visible. These mitigation lands, which are secured behind a gate and accessible only by permission from Sierra Pacific, are used by a small number of hunters and hikers.

Tributary Streams

Two large wildlife mitigation land parcels, Finney Creek and Pressentin, are in the foothills south of the Skagit River downstream of Rockport. These parcels are in steep, forested areas of the foothills and are bisected by small tributaries of the Skagit River. Topography in the foothills is uneven and the tributaries create overlapping ridges, preventing long views of the valley. These parcels are not near the transmission line ROW and have no view of Project facilities. Additionally, access to these mitigation lands is limited by the lack of roads.

Night Sky and Lighting

Because of the Project's location within the North Cascades National Park Complex, development is generally limited to City Light and NPS facilities. City Light informally evaluates each lighting project in a method that is similar to NPS practices. The existing nighttime environment in the Project vicinity is dark, with very limited introduced nighttime lighting on Ross Lake. Ross Lake Resort, Ross Dam, Hozomeen, and traffic along SR 20 introduce limited amounts of light into the otherwise dark nighttime environment. Moving west from Ross Lake, intermittent sources of light such as townsites are intermixed with stretches with very little development. The amount of nighttime light pollution generally increases moving southwest along the Project Boundary and transmission line ROW. Nighttime lighting between Ross Lake and Newhalem is limited to light from the Project, a few NPS facilities such as Colonial Creek Campground, townsites, and traffic along SR 20.

The ELC, Diablo Dam, Diablo Boathouse, and traffic along SR 20 introduce some level of light in the Diablo Lake area in an otherwise dark nighttime environment. For example, see Figure 4.9-6 which shows nighttime lighting at Diablo Dam. Below Diablo Lake, the powerhouse and town of Diablo's housing and administrative buildings generate nighttime lighting. Except for the Diablo townsite, there is very little development along Gorge Lake; the primary source of nighttime lighting along Gorge Lake and the bypass reach is lighting from cars traveling on SR 20 and at the Gorge Dam. Lighting at the Gorge Powerhouse, housing, administrative offices, and the Ladder Creek Falls and Gardens within the town of Newhalem introduce sources of unnatural lighting south of Gorge Lake. The Ladder Creek lights are turned off at 11 p.m.

From the Newhalem townsite to Bacon Creek, there is no permanent development outside of the transmission facilities; the primary source of light in this section is from traffic along SR 20. South of Bacon Creek, lights from residences and buildings in Marblemount begin to be visible. Moving south from Marblemount along the transmission line ROW into the Sauk River valley, light sources diminish again until Darrington, which is a significant source of nighttime lighting due to houses, businesses, and other buildings. Nighttime lighting diminishes slightly from Darrington until Arlington as the settlements in that area are more rural and dispersed in nature. Beginning near Arlington, the nighttime light setting is typical of a suburban development as the transmission line ROW crosses a mix of suburban areas and agricultural lands.

Figure 4.9-6. Nighttime Lighting at Diablo Dam.

4.9.1.3 Relevant Land Management Guidelines

This section describes land management plans relevant to visual resources within the Project vicinity.

National Park Service

Ross Lake Management Plan

The RLNRA GMP outlines a program for managing RLNRA (NPS 2012). Visual resources defined in the GMP as fundamental resources for RLNRA are as follows:

- **Scenery:** Majestic mountain scenery that includes alpine meadows, countless cascades, towering mountains, and forested valleys.
- **Viewpoints:** Majestic mountain scenery is observed from trails, overlooks, and viewpoints.
- **Night Sky:** The general absence of artificial light ensures preservation of majestic nighttime views.

Guidelines for managing visual resources as presented in the GMP are summarized below.

NPS policy for protecting night skies is outlined in the Management Policies 2006 (NPS 2006). The RLNRA GMP identified the following management strategy to preserve night skies:

- Cooperate with park visitors, neighbors, and local government agencies to find ways to prevent or minimize the intrusion of artificial light into the night scene in RLNRA.
- In developed areas, artificial outdoor light will be limited to basic safety requirements and designed to minimize effects on the night sky.
- NPS staff will evaluate the effects on the night sky caused by NPS operations. If light sources in RLNRA are affecting night skies, the staff will consider alternatives such as shielding lights,

changing lamp types, or eliminating unnecessary sources.

- NPS will complete an inventory of night sky conditions and work with partners and adjacent land managers to protect night sky by reducing light pollution within RLNRA and on adjacent lands. For example, NPS will work with City Light to reduce light pollution in Diablo and Newhalem.
- NPS will also factor in night sky for lighting new construction and actively retrofit exterior lighting to improve night sky conditions.

NPS policy for protecting scenic resources is outlined in NPS Organic Act, as well as NPS Management Policies 2006 (NPS 2006). The RLNRA GMP states that NPS staff will work with adjacent and nearby landowners to minimize any visual effects from nearby developments and to ensure that developments do not encroach on Ross Lake (NPS 2012).

U.S. Forest Service

The 1983 Skagit River Management Plan describes the aesthetic setting of the Wild and Scenic Designated Skagit River and its tributaries and outlines management goals and directions for the rivers (USFS 1983). The 1983 Sauk River Management Plan called for USFS to work with City Light to reduce the visual effect of the utility crossing of the Sauk River (Envirosphere 1989).

As outlined in the Mt. Baker-Snoqualmie National Forest LRMP, the following goals and policies apply to management of the Skagit and Sauk rivers (USFS 1990). The Project transmission lines are located along the Sauk and Skagit rivers and cross the Sauk and the Skagit rivers in multiple locations. Therefore, these management plans are relevant to Project transmission line infrastructure. All transmission lines are existing facilities and are allowed within lands managed by USFS.

The overall goal for management of visual resources in the Mt. Baker-Snoqualmie National Forest is to provide an attractive forest setting, emphasizing the natural appearance of areas seen from major roads and recreation sites. The minimum visual quality objective is “maximum modification,” which is defined as follows:

- Maximum modification provides that vegetation and landform alterations resulting from management activities may dominate the characteristic landscape. However, when viewed as background, cut blocks, patches, or strips are shaped and blended to the extent practicable with the natural terrain.
- When viewed as foreground or middle-ground, management treatments may not appear to completely borrow from naturally established form, line color, or texture. Alterations may also be out of scale or contain detail that is incongruent with natural occurrences, as seen in foreground or middle-ground.
- The introduction of structures, roads, slash, and other project-related debris must remain visually subordinate to the proposed composition when viewed as background.
- For this level of management, the reduction in visual contrast of activities and treatments with their surroundings should be accomplished within five years.

Washington State Department of Transportation

US 2 and SR 20 are part of the Washington State Cascade Loop scenic byway. WSDOT has a Visual Engineering Resources Group and requires Visual Quality Analyses to be conducted for all roadside projects which alter roadside character. The following WSDOT plans were reviewed and do not include relevant scenic byway plans or policies: Transportation Asset Management Plan, Development of a Resource Planning Index for Washington's Scenic and Recreation Highways, and the WSDOT Standards Plans (WSDOT 2018, 2019, 2010).

4.9.1.4 Key Viewing Areas

The 1989 Visual Resources Analysis used a methodology adapted from the visual management systems used by USFS, BLM, and WSDOT. These methods were chosen as a portion of the study area is managed by USFS, and WSDOT manages SR 20. Additionally, the BLM's contrast rating system is suitable for the evaluation of built facilities.

The 1989 analysis evaluated existing visual quality in each landscape zone and the visual characteristics of the Project facilities. It identified Key Viewing Areas (KVA), described varying viewer responses, and evaluated the visibility of Project facilities at the KVAs. The analysis then evaluated the visual quality of the existing visual resources using the criteria of vividness, intactness, and unity. Finally, incorporating information about existing visual quality, visual contrast, viewer exposure, and viewer sensitivity, the analysis evaluated the visual effect of Project components in each landscape zone.

KVAs used in the 1989 Visual Resources Analysis and subsequently used in the Visual Quality Mitigation Alternatives Analysis from 1991 were selected in consultation with NPS, USFS, Ecology, and the NCCC to represent typical and important views that are accessible to the public and from which the Skagit River Project facilities are prominent (Envirosphere 1989; City Light 1991a). The types of KVAs included in the 1989 Visual Resources Analysis include NPS campgrounds, overlooks and pullouts along SR 20, trails, resorts, boat docks and ramps, boat portage locations, dam and powerhouse overlooks, bridges, summits of surrounding peaks, and locations along the Skagit and Sauk rivers (Envirosphere 1989). Because of the limited development and changes in public access in the Project vicinity, these KVAs continue to be representative of important vistas and are listed in Table 4.9-1.

Table 4.9-1. KVAs for evaluating visual effects.

Viewpoint Description			Visible Project Features				
Number	**Name**	**Location**	**Dam**	**Powerhouse**	**T-line**	**Town**	**Shore**
1	Hozomeen	NPS Campground					X
2	Big Beaver	NPS Campground					X
3A	Ross Dam	North abutment	X	X	X		X
3B	Ross Dam	South abutment	X	X	X		X
4	Ross Lake Overlook	SR 20 @ MP 135					X
5	Desolation Peak	Lookout					X
6	Sourdough Mountain	Lookout					X
7	Lightning Creek	NPS Campground					X

Viewpoint Description			Visible Project Features				
Number	Name	Location	Dam	Powerhouse	T-line	Town	Shore
8	Tenmile Island	NPS Campground					X
9	East Bank Trail	Trail					X
10	Little Beaver	NPS Campground					X
11	Ross Lake Resort	Resort	X		X		X
12	Ross Lake Resort Dock[1]	Upstream of Ross Dam on south side of reservoir	X		X		X
13	ELC[2]	ELC campus	X	X	X		X
14	Lower Diablo Lake	Near boathouse			X		X
15	Upper Diablo Lake	Haul Road			X		X
16	Ross Dam viewpoint	Ross Powerhouse outside deck	X	X	X		X
17	Gorge Lake Campground	NPS Campground			X	X	X
18	Ross Dam Overlook	SR 20 at MP 133	X		X		X
19	Diablo Lake Overlook	SR 20 at MP 131.8	X		X		X
20	Diablo Townsite Overlook	SR 20 at MP 127	X	X	X	X	X
21	Gorge Lake Bridge #1	SR 20 at MP 126			X		X
22	Gorge Lake Bridge #2	SR 20 at MP 125			X		X
23	Gorge Lake Transmission Line #1	SR 20 at MP 124.5			X		
24	Gorge Lake Transmission Line #2	SR 20 at MP 124.2			X		
25	Gorge Lake Transmission Line #3	SR 20 at MP 123.7			X		
26	MP 123	SR 20 at MP 123	X		X		X
27	Gorge Dam bridge	Gorge Dam Access Road	X		X		X
28	Tunnel 1	SR 20 at West portal			X		X
29	Afternoon Creek	SR 20 at MP 122			X		X
30	Deadman's Curve	SR 20 at MP 121.5			X		X
31	BPR: MP 121	SR 20 at MP 121			X		X
32	Gorge Switchyard	SR 20 at MP 120.9		X	X	X	
33	Newhalem Store	SR 20 at MP 120.7			X	X	
34	Newhalem Campground	Entry bridge (one-lane)			X		
35	Newhalem Visitor's Center	Behind campground			X		

Viewpoint Description			Visible Project Features				
Number	Name	Location	Dam	Powerhouse	T-line	Town	Shore
36	Goodell Creek	NPS Campground			X		
37	Babcock Creek	SR 20 at MP 118.5			X		
38	Thornton Creek Eastbound	SR 20 at MP 117			X		
39	Thornton Creek Westbound	SR 20 at MP 117			X		
40	Thornton Creek Road	Road to Trailhead			X		
41	Trappers Peak	Summit, via waytrail			X	X	
42	Damnation Creek	NPS Campground			X		
43	Talc Mine Eastbound	SR 20 at MP 113.9		X	X		
44	Talc Mine Westbound	SR 20 at MP 113.2			X		
45	Bacon Creek Westbound	SR 20 at MP 111			X		
46	Bacon Creek	Skagit confluence, downriver			X		X
47	Bacon Creek Eastbound	SR 20 at MP 110.5			X		
48	Corkindale Creek	SR 20 at MP 103			X		
49	Corkindale Creek	Transmission line river crossing, upriver			X		X
50	North Cascades National Park Wilderness Information Center (WIC)	Ranger Station Road, Marblemount			X		
51	Backus Creek	WIC access road			X		
52	Corkindale Creek	Transmission line river crossing, downriver			X		X
53	Illabot Creek	Rockport Cascade Road at MP 6		X			
54	Sauk River Park	Sandbar			X		
55	Sauk River Mile 6.8	SR 530			X		
56	Sauk River Mile 7	Southside Road bridge			X		
57	Sauk River Mile 9	SR 530 at MP 59.5			X		
58	Sauk River bridge	SR 530 at MP 56.2			X		
59	Sauk Prairie Road	SR 530 at MP 53.8			X		

Source: Modified from Envirosphere 1989.

1 The Envirosphere 1989 report identified KVA 12 as the Ross Lake Guard Station. The guard station no longer exists but the site is located near the present-day Ross Lake Resort Dock which is used by recreationists, the Ross Lake Resort, City Light, and the NPS.

2 The Envirosphere 1989 report identified KVA 13 as the Diablo Lake Resort. The resort no longer exists but the site was used for the construction of the ELC. The views from the ELC are the same as they were for the resort.

The methodology used to evaluate the effect of Project facilities on the visual setting considered viewer response. The responses from various user groups were evaluated using the following variables: length of stay, season, activity, and viewer expectation. User groups evaluated include residents of townsites, motorists, bicyclists, Skagit Tour participants, visitors to resorts, campers, boaters, anglers, seaplane visitors, backcountry hikers, horse-riders, hunters, birdwatchers, interpretive program participants, skiers, and snowmobilers.

The viewer sensitivity of visitors within the narrow, northeastern arm of Diablo Lake to Project facilities such as the dams was determined to be low because most visitors are either visiting with the intention of viewing Project facilities or are not surprised by their visual presence. However, the sensitivity of viewers to transmission lines is higher as more user groups are exposed to them that may not be seeking views of the Project site. Viewer sensitivity to dams, powerhouses, switchyards, and townsites was determined to be low to moderate within Zone 1 of the Project. Visual sensitivity to shorelines and transmission lines within Zone 1 was determined to be moderate to high. Below Zone 1, transmission lines are the only visible Project facility, and viewer sensitivity was determined to be moderate to high (Envirosphere 1989).

4.9.2 Known or Potential Effects

This section describes the known and potential Project-related and cumulative effects on aesthetic resources that may be associated with continued operation of the Project under a new license.

4.9.2.1 Project-Related Effects

Effects of Reservoir Drawdown

As part of the previous relicensing process, a visual quality study was conducted to evaluate the visual effect of various reservoir levels at Ross Lake (Parametrix 1989). Although there are minor water surface elevation fluctuations in Diablo Lake (4-5 feet daily from a normal maximum water elevation of 1,205 feet) and Gorge Lake (3-5 feet daily from a normal maximum water elevation of 875 feet), drawdown in these reservoirs is not significant, particularly compared to Ross Lake. The 1989 Parametrix study only evaluated the visual effects of drawdown at Ross Lake. Seasonal changes in reservoir levels for Project operations have not changed significantly since the time the 1989 study was conducted. Therefore, the study's analysis of the visual effects of reservoir drawdown of Ross Lake accurately describes existing effects on the visual quality of Ross Lake.

As described in the 1989 Parametrix study, the effect that drawdown levels have on various segments of the shoreline depends on topography, the surrounding vegetation, and the depth of the reservoir near the shoreline. The most significant effect on visual quality from low water levels is at the north end of Ross Lake, which is much shallower than the south end and is where a relatively minor drawdown exposes acres of unvegetated mudflats. The visual effect of drawdown conditions is greater along shoreline areas that are heavily vegetated as opposed to areas where the shoreline is characterized by clay, silt, or sand, which are limited along the Ross Lake shoreline. Four reservoir levels were analyzed in the visual effect assessment:

- The lowest feasible reservoir level (1,523–1,528 feet above sea level)
- 1,567 feet above sea level
- 1,592 feet above sea level

- Full pool (1,602.5 feet above sea level)

The study analyzed effects on five user groups: boaters, hikers, horse riders, car campers, and motorists. Effects were analyzed from 10 different viewpoints around Ross Lake (Parametrix 1989).

The following factors were weighed in the visual assessment: baseline visual quality, contrast, duration of view, viewer sensitivity, and number of viewers. The study determined that at all viewpoints, as reservoir levels decrease, so too does visual quality. However, the effect on visual quality depends on the viewpoint and how sensitive the viewers at a given viewpoint are. Additionally, the greatest visual effects do not necessarily occur at the lowest levels. This is because very few visitors are present during the time of the year with the lowest reservoir levels due to the closure of SR 20, resulting in a smaller cumulative visual effect on viewers. As a result, reservoir drawdown conditions have a temporary, reoccurring adverse effect on visual quality on Ross Lake (Envirosphere 1989).

Effects of Gorge Bypass Reach Flow Levels

As described in Section 4.9.1 of this PAD, flow levels in the bypass reach affect the degree to which the reach appears to have a naturally flowing river. The 1989 Visual Resources Analysis evaluated visual characteristics of the bypass reach using four flow levels: base flow (10 cfs), 50 cfs, 500 cfs, and 1,000 cfs. The visual characteristics evaluated included the following:

- The extent to which the flow level creates a continuous visual appearance.
- The scale of wetted channel in relation to the channel width.
- The extent of whitewater.
- The noticeability of spray or mist, sounds of rushing water, and downstream breeze.

The assessment determined that at base flow, these factors were absent; at 50 cfs, they were present at low levels; and at 500 and 1,000 cfs, they were present in a moderate to high degree at most viewpoints (Envirosphere 1989). The visual effect of the Project on the bypass reach depends on the amount of flow that is released in this section. However, the study determined that, overall, the "dry" appearance of the channel introduces moderate visual effects on the existing visual setting. In addition, because of safety concerns the public is restricted from using the bypass reach, and thus the visual effect is low as it is visible from only a few viewpoints along the highway.

Effects of Project Facilities

To determine the visual effect of Project facilities, the 1989 Visual Resources Analysis analyzed the visual quality, visual contrast, viewer exposure, and viewer sensitivity to Project facilities in each landscape zone. These factors were then combined to determine the overall visual effect of Project facilities. Since the last relicensing period, development in the Project vicinity has been mostly limited to minor Project maintenance and improvements to NPS facilities. The only additional Project facilities include a warehouse in Diablo and the Ross Lake Boathouse on Ross Dam. The barge landing, boat ramp, kayak dock and the ferry dock at the east end of Diablo Lake were relocated and replaced following a landslide; the garages in Newhalem were also removed and replaced. Several structures have been removed, including the houses in Engineers Row, a few homes in Hollywood, and the school in Reflector Bar. A few facilities have been restored, such as the Gorge Inn, the bunkhouses in Newhalem, and Ross Lodge. Additionally, the Diablo Lake Resort was replaced by the ELC. Despite the changes to areas where NPS and other facilities are located, existing visual quality, the visual contrast of Project components, and the viewer sensitivity have not been significantly altered since the 1989 Visual Resources Analysis. The results of the study are summarized in Table 4.9-2.

As demonstrated by Table 4.9-2, the visual effects of the Project dams are moderate to low as most viewers are visiting the dams with the purpose and expectation of seeing them. The visual effects of the powerhouses and switchyards are also moderate to low as viewer sensitivity is moderate to low.

Despite the high contrast that Project facilities and infrastructure have in the townsites, the visual effects of Project facilities in the Newhalem and Diablo town sites were determined to be moderate to low due to the low to moderate viewer sensitivity.

Compared to other Project facilities, the visual effect of the transmission lines is greater because more viewers are exposed to them and viewer sensitivity is generally high. The visual effect of the transmission lines was determined to be high (Envirosphere 1989).

Table 4.9-2. Visual effects of Project facilities.[1]

Landscape Zone Unit	Visual Quality	Visual Contrast	Viewer Exposure	Viewer Sensitivity	Visual Effect
Dams					
Skagit River Project Facility Zone (Zone 2)					
Ross Dam	Very High	Moderate	Moderate	Moderate	Moderate
Ross Canyon	High	High	Moderate	Low	Low
Thunder Arm	High	---	--	Moderate	--
Lower Diablo Lake	High	Moderate	Moderate	Moderate	Moderate
Diablo Townsite	Moderate to High	Moderate	Moderate	Low	Low
Gorge Lake	Moderate to Low	Low	Low	Moderate	Low
Gorge Bypass Reach	Moderate	Moderate	Low	Moderate	Low
Powerhouses and Switchyards					
Skagit River Project Facility Zone (Zone 2)					
Ross Dam	Very High	--	--	Moderate	--
Ross Canyon	High	Moderate	Moderate	Low	Low
Thunder Arm	High	--	--	Moderate	--
Lower Diablo Lake	High	--	--	Moderate	--
Diablo Townsite	Moderate High	High	Moderate	Low	Low
Gorge Lake	Moderate Low	--	--	Moderate	--
Gorge Bypass Reach	Moderate	--	--	Moderate	--
Newhalem Townsite	Moderate High	Moderate	High	Moderate	Moderate
Shorelines					
Upper Ross Lake (Zone 1)					
Upper Ross Lake	High to Very High	Moderate to High	Low to High	Moderate to High	Low to High
Skagit River Project Facility Zone (Zone 2)					
Ross Dam	High	Moderate to High	Moderate to High	Moderate to High	Moderate to High
Ross Canyon	High	Moderate	Moderate	Moderate	Low
Thunder Arm	High	Moderate	High	High	Moderate
Lower Diablo Lake	High	Moderate	High	High	Moderate
Diablo Townsite	Moderate High	Moderate	Moderate	Moderate	Moderate

Landscape Zone Unit	Visual Quality	Visual Contrast	Viewer Exposure	Viewer Sensitivity	Visual Effect
Gorge Lake	Moderate Low	Moderate	High	High	Moderate
Gorge Bypass Reach	Moderate	Moderate	Moderate	Moderate	Moderate
Newhalem Townsite	Moderate High	Moderate	Moderate	Moderate	Moderate
Transmission Line along the Skagit River: Bacon Creek to Rockport (Zone 4)					
Bacon Creek to Marblemount	Moderate	Moderate	High	High	Moderate
Marblemount to Rockport	Moderate	Moderate	High	High	Moderate
Sauk Scenic River Zone					
Flume Creek to Rockport	Moderate High	Moderate	Moderate	High	Moderate
Townsites or Buildings					
Skagit River Project Facility Zone (Zone 2)					
Ross Dam	Very High	--	--	Moderate	--
Ross Canyon	High	Low	Low	Low	Low
Thunder Arm	High	--	--	Moderate	--
Lower Diablo Lake	High	Low	Moderate	Moderate	Low
Diablo Townsite	Moderate High	High	Moderate	Low	Low
Gorge Lake	Moderate Low	--	--	Moderate	--
Gorge Bypass Reach	Moderate	--	--	Moderate	--
Newhalem Townsite	Moderate High	High	High	Moderate	Moderate
Transmission Lines					
Skagit River Project Facility Zone (Zone 2)					
Ross Dam	Very High	Low	Low	Moderate	Low
Ross Canyon	High	High	Moderate	Moderate	Moderate
Thunder Arm	High	Low	Low	Moderate	Low
Lower Diablo Lake	High	High	High	Moderate	High
Diablo Townsite	Moderate High	Moderate	Moderate	Low	Low
Gorge Lake	Moderate Low	High	High	Moderate	High
Gorge Bypass Reach	Moderate	High	High	Moderate	High
Newhalem Townsite	Moderate High	High	High	Moderate	High

Landscape Zone Unit	Visual Quality	Visual Contrast	Viewer Exposure	Viewer Sensitivity	Visual Effect
Ross Lake National Recreation Area: West Entry Zone (Newhalem to Bacon Creek) (Zone 3)					
Goodell Creek to Babcock Creek	Moderate Low	High	High	High	High
Babcock Creek to Damnation Creek	Low	High	High	High	High
Damnation Creek to Bacon Creek	Moderate Low	High	High	High	High
Transmission Line along the Skagit River: Bacon Creek to Rockport (Zone 4)					
Bacon Creek to Marblemount	Moderate	High	High	High	High
Marblemount to Rockport	Moderate	Moderate	High	High	Moderate
Transmission Line along the Sauk Scenic River (Zone 5)					
Flume Creek to Rockport	Moderate High	Moderate	Moderate	High	Moderate
Suiattle River to Flume Creek	Moderate High	High	High	High	High
Darrington to Suiattle River	Moderate	Moderate	Moderate	High	Moderate

Source: Envirosphere 1989; Parametrix 1989.

1 Visual effects in Zone 1 (upper Ross Lake) were analyzed in the 1989 Parametrix study. The Parametrix study used an index of 1–4 to analyze the categories of Visual Quality, Visual Contrast, Viewer Exposure, Viewer, Sensitivity, and Visual Effect. The report developed scores under each these categories for multiple viewing locations along upper Ross Lake. These scores were reviewed and interpreted and are described here in the same reporting index used in the 1989 Visual Resources Analysis.

As described in Section 3.7 of this PAD, the only proposed change to Project facilities would be the addition of a dock along the shoreline of Diablo Lake near the ELC to facilitate Skagit Tours. The addition of this dock would not affect the visual quality of the Project vicinity. Proposed dredging at the upper end of Gorge Lake could temporarily impact the views of the reservoir from Diablo townsite and Gorge Lake Campground. Similarly, there are several major maintenance/restoration/repair projects, such as restoration of the road to Diablo Dam, that could have short-term visual impacts. In general, however, operation of the Project under a new license would result in a continuation of existing visual effects identified in Section 4.9.1.4 of this PAD and possibly a few additional short-term impacts from specific projects.

Effect of Project Facilities on Nighttime Sky

As described above, very little development exists within the Project vicinity. As a result, the primary sources of nighttime lighting are the Project facilities and NPS facilities in the RLNRA. Project facilities include lighting for safety reasons. Operation of the Project introduces a source of artificial light, which results in an adverse effect in an otherwise dark nighttime setting.

4.9.2.2 Cumulative Effects

Under a new license the Project would continue to have direct visual effects due to the contrast of Project facilities with natural landscape features, drawdown of Project reservoirs, low base flow conditions in the bypass reach, and existing safety lighting on Project facilities. These effects in combination with visual effects due to actions implemented by other entities could in some cases result in cumulative visual impacts.

Within the Project vicinity, the following changes could result in effects that could combine with the visual effects of the Project:

- The RLNRA GMP states that the park is facing increased capacity and that changes to park facilities and management will be necessary to accommodate increases in visitors (NPS 2012). Upgrades to NPS facilities to accommodate increased public demand, such as new boat launches, parking, or other visitor facilities, would increase development along the Skagit River. These developments would decrease the unity and intactness of the landscape which, in combination with the contrast of existing Project facilities, could result in cumulative visual effects.
- The RLNRA GMP also outlines that climate change is an increasing concern for fire management. Management actions to address fire concerns such as thinning around facilities and campgrounds would result in a decrease in the intactness and unity of the visual landscape. In combination with existing clearing for Project facilities such as transmission lines, these management actions could combine with the existing visual contrast of the Project and result in cumulative visual effects.
- Existing timber harvest on private lands near the Sauk River and adjacent to the Project’s transmission line corridor will likely continue and could accelerate. In combination with vegetation management within the ROW, clearcutting and harvesting on adjacent private lands could reduce the intactness and unity of views along the Sauk River.
- Mining on any of the many claims in or near the Project Boundary could, in combination with the effects of the Project, result in cumulative effects on botanical resources, increasing net

losses of vegetation in the Project vicinity. For example, Kiewit Infrastructure Co. owns a site near Marblemount that could be developed into a large rock quarry adjacent to the Illabot South and South Marble 40 wildlife mitigation lands on Rockport-Cascade Road near Marblemount (Skagit County Planning and Development Services 2019). Visual effects of such a quarry could combine with visual effects of the transmission line and result in more pronounced visual impacts. Due to the proximity of this proposal to the Illabot South and South Marble 40 mitigation lands, a quarry would impact existing aesthetic conditions near these mitigation lands and would impact the visual experience of visitors to these mitigation lands.

4.9.3 Existing or Proposed Protection, Mitigation, and Enhancement Measures

4.9.3.1 Existing Measures

PME measures for visual resources were developed as part of the 1991 Recreation and Aesthetics Settlement Agreement (City Light 1991b). To address the visual effects of reservoir drawdown and accommodate the summer recreation season, City Light fills Ross Lake as early as possible after April 15 and holds Ross Lake as close to normal maximum water surface elevation as possible through Labor Day. This reduces the overall visual effect of reservoir drawdown by reducing the number of viewers that experience low water conditions.

To mitigate the visual effects of the Project facilities, City Light has implemented most mitigation measures agreed upon during the Settlement Agreement process. The visual contrast and resulting visual effect created by Project facilities has been reduced by painting surge tanks above Diablo and Gorge powerhouses and the structural steel bridge on the Gorge Dam access road bridge with less contrasting colors, and removing the Diablo person-lift. Other measures to improve the visual quality of the townsites and reduce the contrast of Project facilities include planting vegetation to screen facilities; removing buildings; painting buildings in accordance with an approved paint palette to increase the degree to which buildings blend with the natural environment; changing roofing material to reduce contrast with the surrounding environment; blending the pedestrian walkway in Newhalem with surroundings; and relocating storage buildings.

To reduce the visual impacts of the transmission lines in highly visible sites within RLNRA, the Transmission ROW Vegetation Management Plan identified seven Vegetation Target Areas in which vegetation mitigation prescriptions, such as additional plantings, were proposed to better screen the towers and lines while still complying with vegetation clearance requirements (Figure 4.9-7). Outside of the seven areas, the Transmission ROW Vegetation Management Plan identified two prescriptions (Modified Type B and Type E) that were to be followed on all other areas in the transmission ROW on lands owned by City Light or managed by the NPS or USFS (City Light 1991b).

There are a few measures included in the Settlement Agreement that have not been completed to date. City Light is in the process of implementing several of these and consulting with LPs to replace those that present some undesirable environmental impacts (i.e., paving, which can increase runoff from impermeable surfaces).

1994 (left): Towers prominently exposed, the understory is sparse and there is high contrast at the ROW edge. **1998 (right):** Towers are partly screened. Edge contrast is reduced, and road cut partly revegetated.

Figure 4.9-7. Target Area 1: Bacon Creek facing west.

4.9.3.2 Proposed Measures

City Light will conduct a light source inventory of its facilities and develop and implement a plan to reduce light spill where safety considerations allow. City Light will also continue to consult with NPS regarding visual impacts of Project maintenance, lighting, and changes to Project facilities within RLNRA.

4.10 Cultural Resources

This section summarizes the known cultural or historic resources within the Project and surrounding area (Project vicinity). Cultural resources include the locations of human activity, occupation, or usage that contain materials, buildings, structures, or landscapes that were used, built, or modified by people. This section includes: (1) background on applicable laws and regulations; (2) definitions of terms used to describe cultural resources; (3) a preliminary discussion of the Area of Potential Affect (APE); (4) a summary of existing discovery measures and identified cultural resources in the Project vicinity; (5) descriptions of known or potential Project-related effects; and (6) a summary of existing or proposed PME measures. For the purposes of this discussion, the Project vicinity is defined as all lands and waters within the Project Boundary, the bypass reach and recently acquired or transferred fish and wildlife mitigation lands that are outside the current Project Boundary (see Figure 3.2-1 and the detailed mapbook of the Project Boundary appended to this PAD). In addition, the area within approximately one mile of the Project Boundary (called one-mile Study Area) was included in the research scope for cultural resources to provide context.

Some information on topics addressed in this section is sensitive and confidential and is protected from disclosure by Washington State and federal law (e.g., 16 United States Code [U.S.C.] 470hh, 36 CFR § 296.18, and RCW 42.56.300). Privileged and confidential information is not included in this public document and is provided to FERC as a confidential/privileged document appended to this PAD (Cultural Resources Background Summary).

4.10.1 Applicable Laws and Regulations

The relicensing of non-federal hydroelectric projects by FERC is considered a federal undertaking (36 CFR § 800.16(y)). As such, the Project is required to comply with federal laws and regulations, as well as state and local laws that apply to cultural resources. This regulatory framework defines the research, evaluation, consultation, and reporting procedures to be followed for projects under federal jurisdiction, including projects with FERC licenses.

Federal statutes, regulations, and executive orders provide for the protection, management, and/or consideration of cultural resources for projects that are subject to federal jurisdiction. Cultural resources include those listed in the NRHP, considered eligible for listing (both of which are termed “historic properties”) or as yet unevaluated. The identification and evaluation of historic properties, outlined in Section 106 of the NHPA, is summarized below. Additionally, the American Indian Religious Freedom Act (AIRFA), the Archaeological Resources Protection Act (ARPA), the Native American Graves Protection and Repatriation Act (NAGPRA), the Executive Order on Indian Sacred Sites (Executive Order 13007), the Executive Order on Consultation and Coordination with Indian Tribal Governments (Executive Order 13175), FERC’s “Policy Statement on Consultation with Indian Tribes in Commission Proceedings” in Order 635, RCW, and WAC are relevant to cultural resources.

The NHPA (54 U.S.C. 300101 et seq.) and its amendments established the NRHP, identified responsible agencies, and promulgated regulations that form the backbone of federal government action in the areas of historic preservation and historic properties management. Prior to authorizing an undertaking (e.g., the issuance of a FERC license), Section 106 of the NHPA (36 CFR § 800) requires federal agencies, including FERC, to take into account the effect of that undertaking on cultural resources listed or eligible for listing in the NRHP and afford the ACHP a reasonable opportunity to comment on the undertaking. By authority of the NHPA, the ACHP has issued comprehensive regulations, guidelines, and procedures for compliance with Section 106 of the NHPA.

The Section 106 compliance process is coordinated at the state level by the Washington SHPO, represented in Washington State by the Department of Archaeology and Historic Preservation (DAHP). As required by Section 106 of the NHPA, FERC, as the lead federal agency, must consult with DAHP, federally-recognized Indian tribes, applicants for federal assistance, local governments, and any other parties regarding the proposed undertaking and its potential effects on historic properties. Other parties may include the public and non-federally recognized tribes, who have an interest in the effects of the undertaking on historic properties. The goal of consultation is to identify historic properties potentially affected by an undertaking, assess the undertaking’s effects, and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. Under the NHPA and its implementing regulations, the term “historic property” is a legally-defined term applied to “any pre-historic or historic district, site, building, structure, or object included in, or eligible for inclusion in, the NRHP maintained by the [The Secretary of the Interior] SOI.” City Light, as a non-federal party, is assisting FERC in fulfilling its obligations under Section 106 and the ACHP’s implementing regulations at 36 CFR § 800.

The NRHP (54 U.S.C. § 3021), created under the NHPA, is the federal list of historical, archaeological, and traditional cultural resources worthy of preservation. Resources listed in the NRHP include districts, sites, buildings, structures, and objects that are significant in American history, prehistory, architecture, archaeology, engineering, and culture. “Historic properties” are identified using the NRHP eligibility criteria (36 CFR § 60). This criteria identifies the range of resources and kinds of significance that will qualify properties for listing and are written broadly to recognize the wide variety of historic properties associated with prehistory and history. The NRHP is maintained by NPS on behalf of the SOI. NPS has developed criteria to guide the evaluation of cultural resources that may be either listed in or eligible for the NRHP. The NRHP Criteria of Evaluation (36 CFR § 60.4) are:

- **Criterion A:** Associated with events that have made a significant contribution to the broad patterns of our history; or
- **Criterion B:** Associated with the lives of persons significant in our past; or
- **Criterion C:** Embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- **Criterion D:** Have yielded, or may be likely to yield, information important in prehistory or history.

Amendments to Section 106 of the NHPA specify that properties of religious and cultural significance (including traditional cultural properties [TCP]) may be determined to be eligible for inclusion in the NRHP. In carrying out their responsibilities under Section 106, federal agencies are required to consult with any Indian tribes or Native Hawaiian organizations that attach religious or cultural significance to any such properties within the APE of a proposed federal undertaking.

National Register Bulletin (NRB) No. 15, How to Apply the National Register Criteria for Evaluation (NPS 1997), provides guidance on evaluating resources for listing in the NRHP. While cultural resources may be present within the APE, if they do not meet the requirements for listing in the NRHP, they are not considered “historic properties,” as defined in the NHPA. To be listed in the NRHP, a property must have integrity, which is defined as its ability to convey its significance (NPS 1997). There are seven aspects or qualities that define integrity: location, design, setting, materials, workmanship, feeling, and association. A cultural resource being considered for eligibility must meet several of the aspects of integrity to be eligible for listing (as per NRB 15). Additional guidance is provided through NRB No. 36 (Guidelines for Evaluating and Registering Archaeological Properties) and No. 38 (Guidelines for the Evaluation and Documentation of Traditional Cultural Properties). An archaeological site would possess *both* significance and integrity to be eligible for the register (as per NRB 36). Significance is the relative importance of a site within historical context. In addition, the archaeological site must meet at least one of the National Register Criteria (A-D) listed above. Evaluating Traditional Cultural Properties includes unique considerations for context, integrity and significance (as per NRB 38).

Cultural resources less than 50 years old typically do not meet the NRHP criteria (A through D), however there are seven Criteria Considerations that may qualify a resource for the NRHP, as outlined in 36 CFR § 60, NRB No. 15 and No. 22, Guidelines for Evaluating and Nominating

Properties That Have Achieved Significance Within the Last 50 Years (NPS 1998a). The Criteria Considerations are as follows:

- **Criteria Consideration A:** A religious property if it derives its primary significance from architectural or artistic distinction or historical importance; or
- **Criteria Consideration B:** A property removed from its original or historically significant location if it is significant primarily for architectural value, or it is the surviving property most importantly associated with a historic person or event; or
- **Criteria Consideration C:** A birthplace or grave of a historical figure if the person is of outstanding importance and if there is no other appropriate site or building associated directly with his or her productive life; or
- **Criteria Consideration D:** A cemetery that derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or
- **Criteria Consideration E:** A reconstructed property when it is accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived. All three of these requirements must be met; or
- **Criteria Consideration F:** A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historical significance; or
- **Criteria Consideration G:** A property achieving significance within the last 50 years if it is of exceptional importance.

4.10.2 Cultural Resource Definitions

There are three primary categories of cultural resources: archaeological resources, historic built-environment resources, and properties of religious and cultural significance (including traditional cultural landscapes [TCL] and TCPs). The term historic properties includes “properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.” (36 CFR § 800.16 (l)(1). The latter are places associated with the cultural practices or beliefs of a living community that are both rooted in that community’s history and important in maintaining the continuing cultural identity of the community (Parker and King 1990). These categories are not necessarily mutually exclusive due to overlap in different types of historic properties and different time periods. For example, a historic district can have both historic and archaeological elements, and a traditional cultural place may have historic or archaeological features that date to the precontact and/or historic period.

Archaeological Resources: Archaeological resources can include isolated artifacts, features above and/or below ground, and sites that generally date to 50 years old or older. Archaeological resources may be divided into two general time periods: historic and precontact.

- Historic period archaeological resources are those resources that date from 50 to about 250 years ago. Historic period archaeological resources may include the following: homesteads, debris scatters, townsites, residential structures, agriculture-related resources, railroad properties, mining properties, logging properties, road/trail segments and abandoned roads/trails, cemeteries.

- Precontact period archaeological resources date from about 250 years ago to 12,000 years or older. These types of resources may include the following: artifacts manufactured of chipped-stone, groundstone, camps, villages, housepits, trails, cairns, rock alignments, petroglyphs, pictographs, burials and funerary objects, and culturally modified trees. Precontact period archaeological resources may also include features of human activities, such as hearths, storage pits, and tool manufacturing areas.
- Archaeological Sites – An archaeological site in Washington is a geographic locality that contains two or more artifacts and/or features of human construction. An artifact is an object made and/or used by people. Archaeological sites contain material remains that reflect human life or activities that may provide understandings of past human behavior or cultural adaptations and can reflect historic and/or precontact time periods. An archaeological site may span multiple time periods and could include multiple components consisting of historic and precontact resources, as well as features associated with the historic built environment.
- Archaeological District(s) – An archaeological district is a geographically definable area (contiguous or discontiguous) possessing a significant concentration, linkage, or continuity of cultural resources (archaeological and/or historic) united by past events or aesthetically by plan or physical development. An archaeological district could represent historic and/or precontact periods. Archaeological sites and resources within a district are typically identified as contributing, non-contributing, or unevaluated.
- Isolated artifacts – Consist of a single item without associated features or deposits.

Historic Built-Environment Resources: Include buildings, structures, objects, sites, and districts that generally date to activities within the last 50 to 250 years, and typically reflect human construction and activities from this time period (sometimes referred to as "architectural" or the "historic built environment" but are not limited to architectural elements) – see list below. Historic resources in ruin (e.g., collapsed structures, foundations, etc.) are considered historic period archaeological sites.

- Buildings – Administration buildings, courthouses, dormitories, houses, schools, stores, train stations, etc.
- Structures – Automobiles, bridges, canals, dams, highways, irrigation systems, railroad grades, transmission line towers, etc.
- Objects –Boundary markers, fountains, milepost markers, monuments, sculptures, etc.
- Sites – Camp sites, ceremonial sites, designed landscapes, ruins of buildings or structures, trails, etc.
- Districts – A definable geographic area that possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development. Districts can be contiguous or discontiguous (e.g., two or more definable significant areas separated by non-significant areas). They can also contain archaeological resources. Examples include business districts, industrial complexes,

residential areas, transportation networks, etc.

Properties of Religious and Cultural Significance: Properties of religious and cultural significance are described in Section 4.10.5.

4.10.3 Development of the APE

For purposes of Section 106 of the NHPA, a project's APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The area of potential effect is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking." (36 CFR § 800.16[d]). An undertaking, as defined in 36 CFR § 800.3(a), is a requirement for the FERC to consult SHPO, THPOs, and the ACHP as part of the scoping of efforts for the undertaking and defining an APE. In developing an APE through coordination with LPs, both potential direct and indirect effects will be considered for the Project. The APE for direct effects will include physical impacts to historic properties and areas subject to ground disturbance, such as sites used for construction, temporary extra workspaces or storage yards, staging areas, aboveground or in-water facilities, anchor points or stabilizing features, and new or to-be-improved access roads or trails. The APE for indirect effects will include areas potentially subjected to the introduction of visual, atmospheric, or audible elements from the Project that may diminish the integrity, character, or use of historic properties within the APE. This will also include reasonably foreseeable effects that may occur either later in time, be farther removed in distance, or be cumulative.

Project boundaries are used to designate the geographic extent of the hydropower project that FERC determines a licensee must own or control on behalf of its licensed hydropower project. For the APE, City Light proposes using the Project vicinity (as defined in the introduction to Section 4.10). This includes the Project Boundary and areas where Project operations or Project-related recreation activities or other enhancements may cause changes in the character or use of historic properties. The APE will be expanded, as necessary, to consider potential direct and indirect effects identified through outreach to Indian tribes and other LPs during the relicensing process, and as informed by research studies conducted by City Light and LPs. The Project Boundary, bypass reach, and all mitigation lands are depicted in Figure 3.2-1 of this PAD.

4.10.4 Identification and Evaluation of Cultural Resources (Archaeological and Historic)

This section describes the known cultural resources and completed investigations within the Project vicinity and the one-mile Study Area. Properties of religious and cultural significance are described in a following section.

Background research for this PAD was conducted by gathering information from previous cultural resources investigations and records on archaeological and historic built-environment resources within the Project vicinity and one-mile Study Area. Records searches of DAHP's online database, the Washington Information System for Architectural and Archaeological Records Data (WISAARD) were conducted to identify previous surveys within the Project vicinity and one-mile Study Area (see Cultural Resource Background Summary appended to this PAD). The ARMMP (Schalk et al. 2013), HRMMP (City Light 1991a) and reports by City Light and NPS on the results of surveys and studies conducted during the previous relicensing process or the current license period were significant sources of information on cultural resources in and near the Project Boundary. Other records examined include individual site inventory records for the NRHP nominations (Erigero 1990; Johnson 2010); base maps with site and survey locations; letter, survey, and evaluation reports; and the NRHP and state register listings. Summary information is included in the Skagit ARMMP and HRMMP.

Architectural and engineering resource surveys for the Project were completed between 1989 and 1990 by the NPS for City Light (Luxenberg 1989; Erigero 1990; HAER 1990). The surveys were accomplished to Level I standards of the HABS and the HAER, exceeding the minimum levels of documentation required by 36 CFR § 800.4. Results of this survey formed the basis of the initial NRHP nomination.

Portions of the Project vicinity have been surveyed for archaeological resources (see Cultural Resources Background Summary appended to this PAD for details). Previous cultural resources investigations in the Ross Lake area ranged from reconnaissance to intensive level surveys and testing within drawdown zones and in the forested lands above the normal maximum water surface elevation (Mierendorf et al. 1988; Mierendorf et al. 1998). There was also some survey work done for Diablo and Gorge reservoirs (Mierendorf and Luxenberg 1987; Lewarch and Larson 1990). Most of the work was completed between 1988 and 1993. Some testing and data recovery excavations have occurred on Ross Lake under the Skagit ARMMP, largely undertaken by consultants to the NPS. All archaeological work has been conducted in compliance with Section 106 of the NHPA.

Other surveys conducted within the Project vicinity have been for specific projects in accordance with Section 106 of the NHPA, and under the guidance of the Skagit ARMMP and HRMMP. There are also a few surveys that have occurred within the one-mile Study Area. A significant portion of the Project vicinity has not been surveyed for cultural resources including the transmission lines, uplands above normal maximum water surface elevation of all reservoirs, and the bypass reach and mitigation lands themselves.

Overall, 131 investigations have been completed within the Project vicinity and one-mile Study Area, including 43 Project vicinity and 88 within the one-mile Study Area. Of the 43 studies associated with the Project vicinity, 35 are archaeological surveys, one is an architectural survey, three are archaeological monitoring projects, three are data recovery projects, and one is an evaluation of NRHP eligibility.

The results of the background research identified a total of 462 known historic and archaeological resources within the Project vicinity and one-mile Study Area around these areas (Table 4.10-1). There are two NRHP listed districts within the Project Boundary, one historic and one archaeological.

Table 4.10-1. Summary of cultural resources within the Project vicinity and one-mile Study Area.

Resource Type	Within One-mile Study Area (NRHP Eligibility Status)	Within Project Vicinity (NRHP Eligibility Status)	Total
Archaeological Sites	85 (2 eligible, 7 not eligible, 76 unevaluated)	190 (16 eligible as contributing to district, 174 unevaluated)	275
Historic Built-Environment Resources	133 (4 eligible, 81 not eligible, 48 unevaluated)	30 (3 eligible [2 contributing to district], 23 not eligible, 4 have been demolished)	163
Archaeological District	0	1	1
Listed Historic Properties/District	18	5 (includes 1 district)	23
Totals	**236**	**226**	**462**

Historic District: Skagit River and Newhalem Creek Hydroelectric Projects (DT00066)

The Skagit River and Newhalem Creek Hydroelectric projects is a discontiguous historic district containing four hydroelectric developments (Newhalem, Gorge, Diablo, Ross) and two company towns (Newhalem and Diablo) (see Figures 4.10-1 through 4.10-5). While the Newhalem Creek Hydroelectric Project is integral to the development history of the Skagit River Project and thus included in the same historic district, it operated under a separate license (FERC No. 2705). The historic district includes a portion of the town of Newhalem, Newhalem Powerhouse Site, Gorge Powerhouse and Gorge Dam (45WH613), Diablo Powerhouse, a portion of the town of Diablo, the Diablo Incline Railroad, and Diablo Dam, Ross Dam, and Ross Powerhouse (Johnson 2010). The District is divided into five discrete areas designated as Historic Areas as follows: “A” (Town of Newhalem), “B” (Gorge Powerhouse and Dam Complex), “C” (Diablo Powerhouse Complex), “D” (Discontiguous Resources – Diablo Lake, and Newhalem Creek Powerhouse Site), “E” (Ross Powerhouse Complex), and “F” (Town of Diablo, Hollywood Residential Area).

In total, there are 87 contributing resources (67 buildings, 15 structures, 3 sites, and 2 objects) and 25 non-contributing resources (15 buildings, 9 structures, and 1 site) in the Skagit River and Newhalem Creek Hydroelectric projects (Erigero 1990; Johnson 2010; Table 4.10-2). Ross, Diablo and Gorge dams and powerhouses are all listed on the NRHP as are most of the buildings in Newhalem and Diablo. While the townsites have changed over the years, many of the remaining buildings retain their character-defining features. Gorge Inn is the oldest surviving building in Newhalem from the early 1920s when the town was a construction camp. Nearby Ladder Creek Gardens is one of the few landscapes on the NRHP. Diablo includes two buildings designed by the USFS in the 1930s. Diablo also includes the incline railroad which was used to transport workers, equipment, and materials up the steep slope during construction of Diablo and Ross dams. Details on the contributing and non-contributing resources in the Project Boundary can be found on the NRHP nomination forms (Erigero 1990; Johnson 2010).

Figure 4.10-1. West elevation of Gorge Inn, looking east (Historic Area A, Town of Newhalem).

Figure 4.10-2. Ladder Creek Lower Falls (Historic Area B, Gorge Powerhouse and Dam Complex).

Figure 4.10-3. Pathway within Ladder Creek Falls and Gardens with newer interpretive signage (Historic Area B, Gorge Powerhouse and Dam Complex).

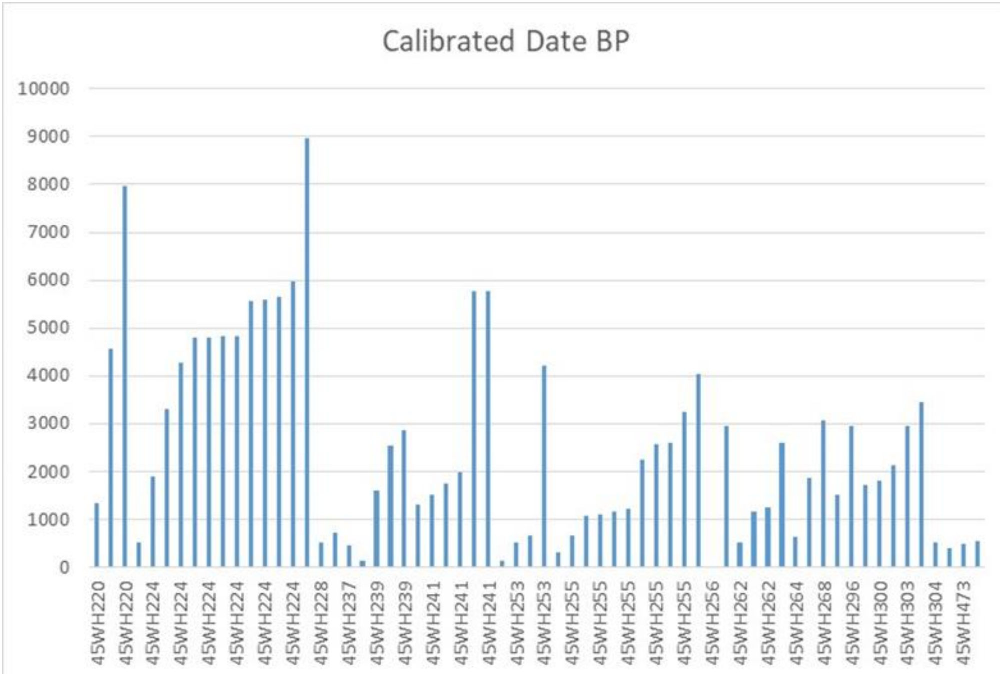
Figure 4.10-4. Silk Stocking Row, view to the south, north elevations of multiple houses (from left to right, SSR 6, 7, and 8)(Historic Area A, Town of Newhalem).

Figure 4.10-5. Ross Lodge after completed rehabilitation (Historic Area F, Town of Diablo, Hollywood Residential Area).

Upper Skagit River Valley Archaeological District (DT00212)

The Upper Skagit River Valley Archaeological District (DT00212) consists of 139 precontact archaeological sites within RLNRA. Of these, 16 are significant and are contributing resources to the District (Mierendorf and Weiser 2004; see detailed summary table in the Cultural Resource Background Summary appended to this PAD). The contributing sites include 45WH00224, 45WH00234, 45WH00237, 45WH00239, 45WH00241, 45WH00253, 45WH00255, 45WH00262, 45WH00268, 45WH00275, 45WH00283, 45WH00286, 45WH00300, 45WH00303, 45WH00473, and 45WH00496.

Initial survey and testing investigations conducted by NPS archaeologists in the late 1980s and 1990s (i.e., Mierendorf et. al 1988; 1998), reflect nearly 10,000 years of human use in the Upper Skagit River Valley Archaeological District. Intensification of use increased in the middle Holocene from about 5,000 years ago to 3,000 years ago. This would have been about the time that cooler, moister conditions spurred a transition from open stand forest to closed canopy mixed Douglas-fir and hemlock forest with a mixed herbaceous understory. Frequent fires during the middle Holocene created patches of improved browsing habitat for large game and increased hunting opportunities. Archaeological data from DT00212 indicates sustained human activity through the late Holocene, reflected through radiocarbon dates and artifact and feature assemblages. Sixty-four radiocarbon dates from nineteen archaeological sites in DT00212 illustrate sustained use of the area spanning thousands of years (Figure 4.10-6). As the forest canopy closed in near the Late Holocene, some areas were maintained through intentional burning, including Chittenden meadow near the head of Ross Lake (e.g., Lepofsky et al. 2003; Lepofsky et al 2005). Individual archaeological sites also reflect repeated use in multiple time periods (Bush et al. 2007; Bush et al. 2008; Bush et al. 2009; Gerrish et al. 2018; Iversen et al. 2012; Iversen et al. 2013; Mierendorf 1993; Mierendorf and Weiser 2004; Mierendorf et al. 1998; Mierendorf et al. 2013; Nelson et al. 2018; Nelson et al. 2019).



Source: Bush et al. 2007; Bush et al. 2008; Bush et al. 2009; Gerrish et al. 2018; Iversen et al. 2012; Iversen et al. 2013; Mierendorf 1993; Mierendorf and Weiser 2004; Mierendorf et al. 1998; Mierendorf et al. 2013; Nelson et al. 2018; Nelson et al. 2019

Figure 4.10-6. Calibrated radiocarbon dates from archaeological sites in Ross Lake. Data derives from Testing and data recovery within the Upper Skagit Archaeological District (DT00212). Calibrations are approximate.

Tools and other types of artifacts and archaeological features reflect a variety of activities associated with hunting, quarrying, tool manufacture or sharpening, food processing, and cooking. The types of stone used reflect local acquisition of materials with occasional transport from greater distances. Assemblages reflect expedient tools and short-term camps and activity areas as well as more finely crafted items that would have required great skill to produce.

By comparison perishable types of items (i.e., composed of plant fibers, wood, bone) are recovered less frequently or not at all. These types of materials decompose over time unless carbonized or capped in place, creating an anaerobic condition and unique preservation environment. Faunal assemblages contain highly fragmented bone of large and small mammals, suggesting local processing and consumption. Blood residue analyses from artifact surfaces also reflect a variety of prey including goat, bear, and small mammals such as rabbit, beaver, squirrel, porcupine or marmot. Paleoethnobotanical remains recovered from cooking hearths, reflect not only plant use but paleoenvironments and these results match up well with pollen core data from Ridley and Thunder Lakes (e.g., Spooner et al. 2007 and 2008).

Listed Historic Built-Environment Resources in the One-mile Study Area

There are 19 historic built-environment resources either listed in the NRHP, or a state register (Washington Heritage Register [WHR]/Washington Heritage Barn Register [HBR]) not associated with the Skagit River Hydroelectric Project but within the one-mile Study Area. These include a cabin, lookout, trail, bridge, three ranger stations, one school, and 10 barns (Table 4.10-2).

Table 4.10-2. Summary of NRHP and state register listed historic properties within the Project vicinity (shaded) and one-mile Study Area.

Resource Line Item and Name [1]	Location	Resource Ownership	Resource Type/ Description	Eligibility[1]
1. Skagit River and Newhalem Creek Hydroelectric Projects DT00066 NR Listing # 11000016	Ross Lake, Diablo Lake, Gorge Lake, Newhalem, and Diablo	City Light	District –Hydroelectric: • Newhalem Creek Powerhouse Site • Hydroelectric plants (Gorge, Diablo, and Ross) • Company towns (Newhalem and Diablo) • Gorge Powerhouse and High Dam • Diablo Powerhouse • Portion of the town of Diablo • Diablo Incline Railroad • Diablo Dam • Ross Dam • Ross Powerhouse	NRHP Listed 2/11/2011
2. Gorge Hydroelectric Power Plant 45WH00613 NR Listing # 89000499	Gorge Lake (DT00066)	City Light	District – Hydroelectric: • Headworks: dam (noncontributing) • Powerhouse and equipment: powerhouse, turbines (contributing) • Water conveyance system: power tunnel, surge tank, and penstocks (contributing)	NRHP Listed 6/30/1989

Resource Line Item and Name [1]	Location	Resource Ownership	Resource Type/ Description	Eligibility[1]
3. Diablo Hydroelectric Power Plant 45WH00612 NR Listing # 89000498	Diablo Lake (DT00066)	City Light	District – Hydroelectric: • Headworks: dam, spillway, slab bridge, outlet pipes, outlet valves, valve house (contributing) • Water conveyance system: power tunnel, intake tower, surge tank, penstocks (contributing) • Powerhouse and equipment: powerhouse, turbines, generators, transformers, tailrace, funicular railway (contributing)	NRHP Listed 6/30/1989
4. International Boundary U.S.-Canada 45WH00624 NR Listing # 88003450	Ross Lake (outside district)	NPS	Site – International boundary	NRHP Listed 2/10/1989
5. Fish and Game-Hozomeen Cabin - North Cascades National Park 45WH00623 NR Listing # 88003454	Ross Lake (outside district)	NPS	Building –Cabin, Hozomeen Lake-Lightning Creek Trailhead	NRHP Listed 2/10/1989
6. Desolation Peak Lookout - North Cascades National Park 45WH00622 NR Listing # 88003451	Ross Lake (outside district)	NPS	Building – Fire lookout	NRHP Listed 2/10/1989
7. Gorge Creek Bridge 45WH00607	Skagit River	WSDOT	Structure – Bridge	WHR Listed 1/25/2002
8. Devil's Corner Cliff Walk 45WH00184 NR Listing # 74000909	Skagit River	NPS	Site – Trail	NRHP Listed 6/7/1974
9. Locomotive #6, Seattle Skagit River Railway 45SK00165	Newhalem	City Light	Object (Structure in 2010 NRHP nomination update) – Locomotive	WHR Listed 11/30/1973
10. Backus--Marblemount Ranger Station House No. 1009 – North Cascades National Park 45SK00274 NR Listing # 88003462	Marblemount	NPS	Building – Federal property	NRHP Listed 2/10/1989

Resource Line Item and Name [1]	Location	Resource Ownership	Resource Type/ Description	Eligibility[1]
11. Backus--Marblemount Ranger Station House No. 1010 - North Cascades National Park 45SK00275 NR Listing # 88003463	Marblemount	NPS	Building – Federal property	NRHP Listed 2/10/1989
12. Darrington Ranger Station 45SN00354 NR Listing # 91000155	Darrington	USFS	Building – Federal property	NRHP Listed 3/6/1991
13. Higgins Barn 45SN00641	Arlington	Private	Building – Barn	WHBR Listed 10/24/2013
14. Oso Elementary School 45SN00120	Oso	Arlington School District	Building – School	WHR Listed 8/31/1973
15. Schmid, Carl, Farm 45SN00707	Arlington	Private	Building – Barn	WHBR Listed 10/16/2015
16. Barn 45SN00670	Marysville	Private	Building – Barn, Anderson Acres	WHBR Listed 10/16/2015
17. Weiser, Howard, Farm 45SN00535	Lake Stevens	Private	Building – Barn, Heineck Farm	WHBR Listed 11/5/2009
18. Wold Farm 45SN00536	Snohomish	Private	Building – Barn, Doughty Farm	WHBR Listed 11/5/2009
19. Jensen, Roy and Edna, Barn SN00527	Snohomish	Private	Building – Barn, Gerspacher Farm	WHBR Listed 5/22/2009
20. Walther, Barnhard, Barn 45SN00481	Everett	Private	Building – Barn, Craven Dairy	WHBR Listed 10/17/2008
21. Bounds, Ray Barn 45SN00538	Snohomish	Private	Building – Barn, Hagen Dairy	WHBR Listed 11/5/2009
22. Morgan, Bill, Farm 45SN00537	Snohomish	Private	Building – Barn, Hagen Dairy	WHBR Listed 11/5/2009
23. Olson Barn Rockport	Rockport	Private	Building – Barn, Board Farm	WHBR Listed 1/25/2008

1 NPS = National Park Service; NR Listing = National Register listing number; NRHP = National Register of Historic Places; WHBR = Washington Heritage Barn Register; WHR = Washington Heritage Register; WSDOT = Washington State Department of Transportation

Eligible, Unevaluated, and Not Eligible Historic Built-Environment Resources

In addition to the listed historic resources discussed above, there are another 163 historic built-environment resources in the Project vicinity and one-mile Study Area. Of the 30 within the Project vicinity (Table 4.10-3), four have been demolished, one has been determined eligible (Skagit/Diablo/Hollywood – House #18 [Property ID #103464], and two are eligible as contributing resources to the Skagit River and Newhalem Creek Hydroelectric projects but not individually (Ladder Creek Water Supply System Property ID #705331 and Skagit/Newhalem/Gorge Suspension Bridge Property ID #103436). Twenty-three have been determined not eligible for listing in the NRHP (Table 4.10-3).

NRHP-Listed, Eligible, and Unevaluated Archaeological Resources

There are a total of 275 previously recorded archaeological sites in the Project vicinity and one-mile Study Area, of which 191 are within the Project vicinity (see the detailed summary of sites in the Cultural Resources Background Summary appended to this PAD). The types of archaeological sites include: precontact lithic scatters (n=185), precontact isolate (n=6), lithic quarries/scatters (n=7), precontact FCR features (n=1), precontact feature (n=1), precontact cairn/rock alignment (n=1), precontact trail (n=1), precontact rockshelter (n=2), culturally modified trees (n=3), multi-component sites (n=7), historic roads (n=2), historic trail (n=1), historic agriculture (n=3), historic homesteads (n=10), historic townsites (n=3), historic cairns (n=1), historic wall (n=1), historic rock pile (n=1), historic rockshelter (n=1), historic debris scatters (n=11), historic isolate (n=1), historic railroads (n=7), historic mining property (n=1), historic logging properties (n=3), historic cabins (n=7), historic structures (n=4), undated pit features (n=1), and cemetery (n=3).

Of the sites within the Project vicinity, 16 are considered contributing to a NRHP-eligible district (Upper Skagit River Valley Archaeological District). Of the 84 archaeological resources outside the Project vicinity, an additional two archaeological sites have been determined eligible for the NRHP (45WH00477 and 45SK00139). The remaining 175 sites in the Project vicinity are unevaluated.

Archaeological Resources Recommended Not Eligible

Twenty-one archaeological resources within the Project vicinity have been previously recommended not eligible for the NRHP by field investigations (Mierendorf et al. 1998); however, their eligibility status is listed as unevaluated in WISAARD (see Cultural Resources Background Summary appended to this PAD).

Table 4.10-3. Summary of additional historic built-environment resources within the Project vicinity (shaded) and one-mile Study Area.

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
1	Ross Lake Suspension Bridge (aka Diablo Lake Trail Bridge)	Diablo Lake	NPS	Structure – Bridge, Ross Lake Suspension Bridge	Historic Contributing
2	John P. Waterfall Bridge (20/348) Property ID #710280	Ross Lake	NPS	Structure – Bridge, John Pierce Waterfall Bridge (20/348), Horsetail Falls Creek Bridge	Eligible 6/26/2017
3	Skagit/Diablo/ Hollywood - House #18 Property ID #103464	Diablo	City Light	Building – Single dwelling	Eligible 5/14/2019
4	Residence H-16 Property ID #98762	Diablo	City Light	Building – Single dwelling	Demolished
5	Skagit/Diablo/ Reflector Bar - Garages #8-19 Property ID #103496	Diablo	City Light	Building – Garage	Not Eligible 5/14/2019

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
6	Skagit/Diablo/ Reflector Bar - House B11 Property ID #103494	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
7	Skagit/Diablo/ Reflector Bar - House B12 Property ID #103493	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
8	Skagit/Diablo/ Reflector Bar - House B4 Property ID #103483	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
9	Skagit/Diablo/ Reflector Bar - Garage B3 & B4 Property ID #103478	Diablo	City Light	Building – Garage	Not Eligible 5/14/2019
10	Skagit/Diablo/ Reflector Bar - House B3 Property ID #103479	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
11	Skagit/Diablo/ Reflector Bar - House B2 Property ID #103481	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
12	Skagit/Diablo/ Reflector Bar - House B1 Property ID #103480	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
13	Skagit/Diablo/ Reflector Bar - Garage B1 & B2 Property ID #103482	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
14	Reflector Bar Residence/ Diablo Residence No. 1101 Property ID #44870	Diablo	City Light	Building – Single dwelling	Demolished
15	Skagit/Diablo/ Reflector Bar - House B5 Property ID #103484	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
16	Skagit/Diablo/ Reflector Bar - Garage B5 & B6 Property ID #103486	Diablo	City Light	Building – Garage	Not Eligible 5/14/2019
17	Skagit/Diablo/ Reflector Bar - House B6 Property ID #103485	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
18	Skagit/Diablo/ Reflector Bar - House B7 Property ID #103490	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
19	Skagit/Diablo/Reflector Bar - Garage B7 & B8 Property ID #103487	Diablo	City Light	Building – Garage	Not Eligible 5/14/2019
20	Skagit/Diablo/Reflector Bar - Garage B9 Property ID #103492	Diablo	City Light	Building – Garage	Not Eligible 5/14/2019
21	Skagit/Diablo/ Reflector Bar - House B8 Property ID #103489	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
22	Skagit/Diablo/ Reflector Bar - House B9 Property ID #103488	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
23	Skagit/Diablo/Reflector Bar - Garage H15 Property ID #103491	Diablo	City Light	Building – Garage	Not Eligible 5/14/2019
24	Residence B-15 Property ID #98761	Diablo	City Light	Building – Single dwelling	Demolished
25	Skagit/Diablo/ Reflector Bar - House B10 Property ID #103477	Diablo	City Light	Building – Laundry	Not Eligible 5/14/2019
26	Skagit/Diablo/ Reflector Bar - House B11 Property ID #103494	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
27	Skagit/Diablo/Reflector Bar - Garages B17, B18 & B19 Property ID #103476	Diablo	City Light	Building – Garage	Not Eligible 5/14/2019
28	Skagit/Diablo/ Reflector Bar - House B12 Property ID #103493	Diablo	City Light	Building – Single dwelling	Not Eligible 5/14/2019
29	Ladder Creek Water Supply System Property ID #705331	Newhalem	City Light	Structure – Supply system	Eligible – contributing 5/25/2017
30	Skagit/Newhalem/Gorge - Suspension Bridge Property ID #103436	Newhalem	City Light	Structure – Bridge, Ladder Creek Bridge	Eligible – contributing 12/21/2010
31	Skagit/Newhalem - Trail of the Cedars Suspension Bridge Property ID #103521	Newhalem	City Light	Structure – Bridge	Not Eligible 12/21/2010
32	Thornton Creek Bridge Property ID #706548	Skagit River Downstream	NPS	Structure – Bridge	Not Eligible 9/8/2016
33	Portage Property ID #14307	Skagit River Downstream	USFS	Site – Portage	Unevaluated
34	Skagit River Bridge – Marblemount Property ID #14271	Marblemount	USFS	Structure – Bridge	Unevaluated
35	Marblemount Ranger Station-Shop Property ID #46990	Marblemount	USFS	Building – shop	Eligible (no date)
36	Backus Ranger Station, Marblemount Ranger Station Property ID #51542	Marblemount	USFS	Building – Federal property	Eligible 5/22/2007
37	Building #1015/ Residence Property ID #705273	Marblemount	USFS	Building – Single dwelling	Unevaluated
38	Building #1013/ Residence Property ID #705271	Marblemount	USFS	Building – Single dwelling	Unevaluated
39	Building #1012/ Residence Property ID #705268	Marblemount	USFS	Building – Single dwelling	Unevaluated

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
40	Building #1001/ Office Property ID #705266	Marblemount	USFS	Building – office	Unevaluated
41	Building #1002/ Transient Housing Property ID #705264	Marblemount	USFS	Building – Single dwelling	Unevaluated
42	Allen house Property ID #104824	Marblemount	Private	Building – Single dwelling	Not Eligible 4/28/2010
43	Bunner house Property ID #104893	Marblemount	Private	Building – Single dwelling	Not Eligible 4/28/2010
44	Government Bridge Property ID #55509	Rockport	Skagit County	Structure – Bridge, Skagit County Bridge #40099	Unevaluated
45	Ed Campbell Property ID #670208	Darrington	Private	Building – Single dwelling	Not Eligible 3/7/2013
46	Darrington Ranger Station - Residence 1229 Property ID #705678	Darrington	USFS	Building – Federal property	Unevaluated
47	Residence Property ID #700823	Arlington	Private	Building – Single dwelling	Not Eligible 2/18/2016
48	Douglass Leland Property Property ID #114137	Arlington	Private	Building – Single dwelling	Not Eligible 2/7/2011
49	Residence Property ID #256273	Arlington	Private	Building – Single dwelling	Unevaluated
50	Residence Property ID #248934	Arlington	Private	Building – Single dwelling	Unevaluated
51	Residence Property ID #248911	Arlington	Private	Building – Single dwelling	Unevaluated
52	Residence Property ID #248905	Arlington	Private	Building – Single dwelling	Unevaluated
53	Residence Property ID #248876	Arlington	Private	Building – Single dwelling	Unevaluated
54	Residence Property ID #248865	Arlington	Private	Building – Single dwelling	Unevaluated
55	Douglass/Leland Pumphouse Property ID #114807	Arlington	Private	Structure	Unevaluated
56	Douglass/Leland Shed 1 Property ID #114806	Arlington	Private	Structure	Unevaluated
57	Douglass/Leland Residence Property ID #114802	Arlington	Private	Building – Single dwelling	Unevaluated
58	Residence Property ID #18631	Arlington	Private	Building – Single dwelling	Unevaluated
59	Norman Cottage Property ID #18630	Arlington	Private	Building – Single dwelling	Unevaluated
60	Grobe Cottage Property ID #18629	Arlington	Private	Building – Single dwelling	Unevaluated
61	Residence Property ID #18628	Arlington	Private	Building – Single dwelling	Unevaluated

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
62	Residence Property ID #18627	Arlington	Private	Building – Single dwelling	Unevaluated
63	Residence Property ID #675280	Arlington	Private	Building – Single dwelling	Not Eligible 6/8/2015
64	Residence Property ID #675281	Arlington	Private	Building – Single dwelling	Not Eligible 7/21/2014
65	Residence Property ID #256272	Arlington	Private	Building – Single dwelling	Not Eligible 3/2/2012
66	Residence Property ID #218048	Arlington	Private	Building – Single dwelling	Not Eligible (no date)
67	Jupp House Property ID #97807	Arlington	Private	Building – Single dwelling	Not Eligible 11/5/2009
68	Levrick house Property ID #105763	Arlington	Private	Building – Single dwelling	Not Eligible 6/15/2010
69	Residence Property ID #18619	Oso	Private	Building – Single dwelling	Unevaluated
70	Oso Bridge Property ID #50689	Oso	Snohomish County	Structure – Bridge	Unevaluated
71	Residence Property ID #18585	Oso	Private	Building – Single dwelling	Unevaluated
72	Oso Fishing Cabins Property ID #50933	Oso	Private	Building – Cabins	Unevaluated
73	JAR Farm single-family residence Property ID #257050	Oso	Private	Building – Single dwelling	Unevaluated
74	Oso General Store Property ID #271907	Oso	Private	Building – Store	Not Eligible 9/20/2017
75	Seattle Lake Shore and Eastern - Arlington Depot Property ID #18590	Arlington	Private	Structure – Railroad depot	Unevaluated
76	Jim Creek Radio Station - Gate House / Bldg #5 Property ID #678511	Arlington	DOD	Building – Gate house	Not Eligible 12/27/2017
77	Residence Property ID # 228588	Arlington	Private	Building – Single dwelling	Unevaluated
78	Residence Property ID #228767	Arlington	Private	Building – Single dwelling	Not Eligible 9/21/2017
79	Switchyard, BPA Murray Substation Property ID #716740	Arlington	BPA	–Structure – Switchyard	Eligible 11/1/2018
80	Residence Property ID #251444	Marysville	Private	Building – Single dwelling	Unevaluated
81	Residence Property ID #251175	Marysville	Private	Building – Single dwelling	Unevaluated
82	Residence Property ID #226441	Marysville	Private	Building – Single dwelling	Not Eligible (no date)

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
83	Residence Property ID #700967	Marysville	Private	Building – Single dwelling	Not Eligible 2/10/2016
84	Residence Property ID #709249	Marysville	Private	Building – Single dwelling	Not Eligible 3/13/2017
85	Residence Property ID #96749	Marysville	Private	Building – Single dwelling	Not Eligible 10/19/2009
86	Residence Property ID #96748	Marysville	Private	Building – Single dwelling	Not Eligible 10/19/2009
87	Residence Property ID #96747	Marysville	Private	Building – Single dwelling	Not Eligible 10/19/2009
88	Residence Property ID #96746	Marysville	Private	Building – Farmstead	Not Eligible 10/19/2009
89	Residence Property ID #705875	Marysville	Private	Building – Single dwelling	Not Eligible 5/31/2016
90	Residence Property ID #251704	Marysville	Private	Building – Single dwelling	Not Eligible (no date)
91	Residence Property ID #213052	Marysville	Private	Building – Single dwelling	Not Eligible 8/13/2015
92	Agricultural Outbuilding Property ID #678576	Marysville	Private	Building – Single dwelling	Not Eligible 8/13/2015
93	Agricultural Outbuilding Property ID #678602	Marysville	Private	Building – Barn	Not Eligible 8/13/2015
94	Residence Property ID #251151	Marysville	Private	Building – Single dwelling	Not Eligible (no date)
95	Agricultural Outbuilding Property ID #678577	Marysville	Private	Building – Barn	Not Eligible 8/13/2015
96	Residence Property ID #253463	Marysville	Private	Building – Single dwelling	Not Eligible 11/13/2013
97	Residence Property ID #251346	Marysville	Private	Building – Single dwelling	Not Eligible (no date)
98	Residence Property ID #709760	Marysville	Private	Building – Single dwelling	Not Eligible 7/2/2018
99	Residence Property ID #709753	Marysville	Private	Building – Single dwelling	Not Eligible 7/2/2018
100	Residence Property ID #709755	Marysville	Private	Building – Single dwelling	Not Eligible 7/2/2018
101	Residence Property ID #709757	Marysville	Private	Building – Single dwelling	Not Eligible 7/2/2018
102	Residence Property ID #709759	Marysville	Private	Building – Single dwelling	Not Eligible 7/2/2018
103	Residence Property ID #251281	Marysville	Private	Building – Single dwelling	Not Eligible 12/5/2011 10/10/2013
104	Hillcrest Elementary School Property ID #679616	Lake Stevens	Private	Building – School	Not Eligible 2/8/2016
105	Residence Property ID #257353	Lake Stevens	Private	Building – Single dwelling	Not Eligible (no date)

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
106	Residence Property ID #700870	Lake Stevens	Private	Building – Single dwelling	Not Eligible 2/25/2016
107	Lake Stevens Middle School Property ID #679619	Lake Stevens	Private	Building – School	Not Eligible 2/8/2016
108	Residence Property ID #108801	Everett	Private	Building – Single dwelling	Not Eligible 9/21/2010
109	Residence Property ID #258323	Lake Stevens	Private	Building – Single dwelling	Not Eligible (no date)
110	Nordin, J. Warren and Betty J., Farm Property ID #55936	Everett		Building – Barn, agriculture	Not Eligible 1/14/2008
111	Residence Property ID # 55352	Everett	Private	Building – Single dwelling	Unevaluated
112	Residence Property ID #55350	Everett	Private	Building – Single dwelling	Unevaluated
113	Residence Property ID #55351	Everett	Private	Building – Single dwelling	Unevaluated
114	Residence Property ID #55349	Everett	Private	Building – Single dwelling	Unevaluated
115	Residence Property ID #55348	Everett	Private	Building – Single dwelling	Unevaluated
116	Residence Property ID #55347	Everett	Private	Building – Single dwelling	Unevaluated
117	Residence Property ID #55345	Everett	Private	Building – Single dwelling	Unevaluated
118	Residence Property ID #55346	Everett	Private	Building – Single dwelling	Unevaluated
119	Residence Property ID #55343	Everett	Private	Building – Single dwelling	Unevaluated
120	Residence Property ID #55342	Everett	Private	Building – Single dwelling	Unevaluated
121	Residence Property ID #55341	Everett	Private	Building – Single dwelling	Unevaluated
122	Residence Property ID #55340	Everett	Private	Building – Single dwelling	Unevaluated
123	Residence Property ID #55339	Everett	Private	Building – Single dwelling	Unevaluated
124	Residence Property ID # 669649	Everett	Private	Building – Single dwelling	Not Eligible 1/15/2013
125	Residence Property ID #55937	Everett	Private	Building – Single dwelling	Not Eligible 1/14/2008
126	Everett Water Main Bridge 9/125Property ID #55938	Everett	WSDOT	Structure – Bridge	Not Eligible 1/14/2008
127	Residence Property ID #55935	Everett	Private	Building – Single dwelling	Not Eligible 1/14/2008
128	Residence Property ID #55934	Everett	Private	Building – Single dwelling	Not Eligible 1/14/2008

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
129	Residence Property ID #55933	Everett	Private	Building – Single dwelling	Not Eligible 1/14/2008
130	Residence Property ID #55932	Everett	Private	Building – Single dwelling	Not Eligible 1/14/2008
131	Residence Property ID #221373	Everett	Private	Building – Single dwelling	Not Eligible 4/5/2018
132	House Property ID #112169	Snohomish	Private	Building – Single dwelling	Unevaluated
133	Residence Property ID #112168	Snohomish	Private	Building – Single dwelling	Not Eligible 12/8/2009
134	Residence Property ID #112167	Snohomish	Private	Building – Single dwelling	Unevaluated
135	Residence Property ID #258158	Snohomish	Private	Building – Single dwelling	Not Eligible (no date)
136	Residence Property ID #257146	Snohomish	Private	Building – Single dwelling	Not Eligible 6/18/2014
137	Residence Property ID #257815	Snohomish	Private	Building – Single dwelling	Not Eligible 6/18/2014
138	Residence Property ID #258380	Snohomish	Private	Building – Single dwelling	Not Eligible 6/18/2014
139	Residence Property ID #221398	Snohomish	Private	Building – Single dwelling	Not Eligible 9/24/2015
140	Hunt House Property ID #105286	Snohomish	Private	Building – Single dwelling	Not Eligible 5/25/2010
141	Residence Property ID #257659	Snohomish	Private	Building – Single dwelling	Not Eligible (no date)
142	Heirman Root Cellar Property ID #718232	Snohomish	Private	Structure – Root cellar	Not Eligible 4/2/2019
143	Heirman Barn Property ID #718241	Snohomish	Private	Building – Barn	Not Eligible 4/2/2019
144	Heirman Chicken Coop Property ID #718240	Snohomish	Private	Structure – Chicken coop	Not Eligible 4/2/2019
145	Heirman Garage and Storage Building Property ID #718228	Snohomish	Private	Building – Garage	Not Eligible 4/2/2019
146	Residence Property ID #115836	Snohomish	Private	Building – Single dwelling	Not Eligible 3/22/2011
147	Residence Property ID #244214	Snohomish	Private	Building – Single dwelling	Not Eligible (no date)
148	Residence Property ID #676345	Snohomish	Private	Building – Single dwelling	Not Eligible 10/30/2014
149	Residence Property ID #114694	Snohomish	Private	Building – Single dwelling	Not Eligible 2/16/2011
150	Residence Property ID #214700	Snohomish	Private	Building – Single dwelling	Not Eligible (no date)
151	Residence Property ID #257837	Snohomish	Private	Building – Single dwelling	Not Eligible 6/29/2017

Line Number	Resource Name[1]	Location	Resource Ownership	Resource Type	NRHP Eligibility
152	Brown House Property ID #90733	Snohomish	Private	Building – Single dwelling	Not Eligible 3/12/2009
153	Residence Property ID #17927	Snohomish	Private	Building – Single dwelling	Unevaluated
154	Residence Property ID #229894	Snohomish	Private	Building – Single dwelling	Not Eligible (no date)
155	Residence Property ID #674020	Bothell	Private	Building – Single dwelling	Not Eligible 2/19/2014
156	Residence Property ID #672344	Bothell	Private	Building – Single dwelling	Not Eligible 6/17/2014
157	Residence Property ID #674235	Bothell	Private	Building – Single dwelling	Not Eligible 9/6/2017
158	Residence Property ID #674233	Bothell	Private	Building – Single dwelling	Not Eligible 9/6/2017
159	Residence Property ID #674231	Bothell	Private	Building – Single dwelling	Not Eligible 9/6/2017
160	Residence Property ID #231377	Bothell	Private	Building – Single dwelling	Not Eligible 9/6/2017
161	Residence Property ID #674227	Bothell	Private	Building – Single dwelling	Not Eligible 9/6/2017
162	Residence Property ID #708626	Bothell	Private	Building – Single dwelling	Not Eligible 2/14/2017
163	Residence Property ID #230068	Bothell	Private	Building – Single dwelling	Not Eligible (no date)

1 Property ID = DAHP ID number; NPS = National Park Service; USFS = US Forest Service
Note: one historic resource (Property ID #680181) shows in WISAARD map; however, no information is provided. Therefore, this resource is not included in the table.

4.10.5 Identification and Evaluation of Properties of Religious and Cultural Significance

Properties of religious and cultural significance are resources associated with cultural practices or beliefs of a living community rooted in that community's history, and important in maintaining the continuing cultural identity of the community (Parker and King 1998). Properties of religious and cultural significance include TCPs, which are those properties that are eligible for listing in the NRHP. TCPs can be either tangible resources containing physical evidence or intangible without any man-made physical features. DAHP defines TCPs as "a distinctive natural site, such as a mountaintop, or a historic environment, such as an ethnic neighborhood, or it may simply be a place with significant historic value to a specific ethnic or cultural group…based upon historic cultural beliefs, customs, or practices which may or may not continue to the present" (DAHP 2014). As adapted from NRB 38, the following are types of TCPs:

- A location associated with the traditional beliefs of an Indian tribe about its origins, its cultural history, or the nature of the world.
- A rural community whose organization, buildings and structures, or patterns of land use reflect the cultural traditions valued by its long-term residents.

- A location where Indian religious practitioners have historically gone, and are known to go today, to perform ceremonial activities in accordance with traditional cultural rules of practice.
- An urban neighborhood that is the traditional home of a particular cultural group, and that reflects its beliefs and practices.
- A location where a community has traditionally carried out economic, artistic, or other cultural practices important in maintaining its historic identity.

Additionally, properties of religious and cultural significance can include TCLs (ACHP 2019, 2016). Within the NRHP, TCLs are a type of significance rather than a property type (e.g., district, building, structures, sites, and objects), and a TCL can be more than one property type. TCLs can be comprised of many features that are often linked, and similar to TCPs, and can be tangible and intangible. They often include physical components, as well as visual and audio considerations (ACHP 2019). Some examples of TCLs include:

- Natural features (e.g., outcroppings, mountains, caves, rockshelters)
- Water bodies (e.g., rivers, streams, lakes)
- Views and viewsheds
- Vegetation (e.g., significant species, forests)
- Human-made features (e.g., archaeological sites, structures, trails, petroglyphs, burials, cairns, markers, monuments, and geoglyphs)

Three federally-recognized tribes were consulted for the first relicense and 1995 settlement agreements based upon their historical, religious, and cultural ties to the general Project area at that time, including the Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community. A study in 1990 was undertaken (Blukis-Onat 1990) to identify areas of religious and cultural significance to these groups within the Project. In addition, First Nations bands of the Nlaka'pamux in Canada were included in settlement agreements due to their historical, religious and cultural ties to the Project Boundary.

As part of the settlement agreements for the current FERC license, City Light funded TCP studies as well as in-lieu mitigations.[39] The TCP studies were funded through administrative MOAs with the Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community (City Light 1991b, c, d, 1996) and Nlaka'pamux Nation (1993). The MOAs emphasized that the tribes and First Nation would direct the TCP studies using qualified professional Principal Investigators (ethnographers), report to City Light on progress and produce both confidential and non-confidential draft and final reports. The scope of work in the MOAs laid out the main elements of the studies, archival review, informant interviews, field visits, and report content and confidential appendices. The main goals of the studies were to: (1) identify TCP properties and geographic locations within the Skagit River Project vicinity; (2) evaluate identified TCPs within the Skagit River Project; (3) determine the effect of continuing Skagit River Project operations on identified TCPs; and (4) develop measures to mitigate unavoidable adverse impacts to TCPs within the Skagit River Project.

[39] In-lieu mitigation occurs when City Light provides funds to an in-lieu-fee sponsor instead of completing project-specific mitigation and/or mitigation occurs offsite.

The Swinomish Indian Tribal Community conducted a TCP study and submitted a final report stating that the Swinomish Indian Tribal Community would like to be consulted on all ethnographic and archaeological work in the Project vicinity (Miller 2000). The report also expressed the desire for access to hunt and collect traditional foods medicines, basketry materials, rocks and minerals, dyes, and secluded undeveloped places to practice traditional religion. The report recommended that further research should include an archaeological survey of the transmission line from Newhalem to Bothell, a survey to document culturally-modified trees throughout the Project vicinity, and ongoing monitoring of other known archaeological sites in the Project vicinity. The report also states that new construction should not begin without an understanding of the "storied" aspects of the locale and landscape – i.e., where natural features personified in traditional epics provide inspiration and connection to traditional oral histories. The report suggests that a booklet be made available locally that emphasizes traditional native cultures of the Skagit River and continuing contributions to the region, either as one document, or as separate documents for the three tribes (Swinomish Indian Tribal Community, Sauk-Suiattle Indian Tribe, and Upper Skagit Indian Tribe).

TCP studies were conducted by the Sauk-Suiattle Indian Tribe, Upper Skagit Indian Tribe, and Nlaka'pamux Nation for RLNRA. The Nlaka'pamux Nation provided results in a draft report submitted to City Light (Laforet 2014); however, the Sauk-Suiattle Indian Tribe and Upper Skagit Indian Tribe have not provided any reports to date. An additional TCP study was completed for the current Project license by a City Light consultant; however, the results are confidential (Blukis-Onat 1990).

In addition to the identification efforts driven by the former relicensing studies, settlement agreements, and management plans, City Light provided seed funding for and participates on the board of the SEEC. Examples of research studies resulting from SEEC grants and conducted by NPS include identifying archaeological resources and tool stone sources relevant for context but outside the Project vicinity and the Hozomeen Gathering, which was hosted by the NPS at facilities in Hozomeen and centered on cultural importance of the Ross Lake area with participants from tribes, First Nations, and City Light.

4.10.6 Known or Potential Effects

This section describes known or potential Project-related and cumulative effects on historic properties that may be associated with continued operation of the Project under a new license.

Years of investigations prior to and during the current Project license have resulted in the identification and evaluation of many historic properties in the Project vicinity, as discussed above. Project effects on historic properties, as they pertain to the current Project license and are within the Project Boundary, have been assessed by applying the criteria of adverse effects (36 CFR § 800.5). Adverse effects have been mitigated through the activities outlined in the 1991 and 1993 Settlement Agreements (City Light 1991b, 1991c, 1991d, 1991e, 1993), MOAs and the Skagit ARMMP and HRMMP. However, for resources such as TCPs and TCLs, the process of identifying historic properties within the Project vicinity is still underway. In addition, there are some areas within the Project vicinity, such as the transmission line and recently acquired wildlife and fish mitigation lands that have not yet been evaluated.

4.10.6.1 Project-Related Effects

Project effects are the undertaking activities that may alter any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. There are two categories of Project effects that require review under Section 106 of the NHPA – direct and indirect. The types of direct effects on a historic property, which are usually adverse, may include, but are not limited to the following:

- Physical destruction of or damage to all or part of the property;
- Alteration of a property that is not consistent with The Secretary of the Interior’s Standards (SOIS) for the Treatment of Historic Properties and applicable guidelines;
- Removal of the property from its historic location;
- Change of the character of the property’s use or of physical features within the property’s setting that contribute to its historic significance; and/or
- Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization.

Indirect effects may also alter any of the characteristics of a historic property that qualify the property for inclusion in the National Register as noted above. These effects include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative. Indirect effects may include, but are not limited to:

- Change of the character of the property’s use or of physical features within the property's setting that contribute to its historic significance (e.g., reduced, limited, or altered access to a property causing neglect and deterioration; or conversely, increased access to a property facilitating vandalism; can be temporary or lengthy in duration); and
- Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property’s significant features (e.g., viewsheds, dust, noise, vibration, temporary or lengthy in duration, etc.).

When an adverse effect is found (e.g., when an undertaking alters directly or indirectly any of the characteristics of a historic property), impacts to archaeological resources could be from ground-disturbing activities or erosion, either directly or indirectly caused by the Project (undertaking). Ground-disturbing activities such as road building or facilities improvements may result in the exposure of previously unidentified archaeological deposits or may cause damage to known historic properties. Erosion of the reservoir shorelines could potentially expose buried archaeological sites and reduce site integrity through erosional processes or exposure to vandalism or looting. Erosion could also affect native vegetation or natural environments that have traditional cultural significance (see Sections 4.6 and 4.11 of this PAD). Adverse effects to historic built-environment resources, such as buildings, structures, sites, or historic districts, could range from demolition, the partial removal of architectural or structural elements, the addition of new features, and/or changes to the surrounding historic context of a resource (e.g., viewshed).

Some of the same types of Project-related effects documented to date are expected to continue beyond the current license period. Based upon prior archaeological and historic built-environment inventories, the known and most predictable locations of continued Project-related effects to historic properties are in reservoir environments and in and around Project infrastructure. For example, in the current license period, reservoir operations have caused direct effects from erosion (i.e., data loss), sedimentation (i.e., capping), and changes to access (i.e., inundation) to NRHP-eligible archaeological sites that contribute to Archaeological District DT00212 (see Cultural Resources Background Summary appended to this PAD). Reservoir operations have also caused indirect effects consisting of visual and landscape changes within the district. Such Project-related effects have guided the management and mitigative actions in the Skagit ARMMP.

Much of the Project's infrastructure is included in a NRHP listed historic district (DT0066) but not all are considered "historic contributing" to it. For those that are, Project-related effects have resulted from upgrades to, and maintenance and replacement of some features; historic rehabilitation projects; or the removal of aging buildings. When rehabilitation projects are completed with replacement in-kind, they are generally considered to be non-adverse; however, when features or buildings are removed or significantly changed the effects may be considered adverse. When these types of actions occur, City Light follows the process guidelines in the Skagit HRMMP; and the mitigation of adverse effects follows Section 106 of the NHPA.

Potential adverse effects to properties of religious and cultural significance (including TCLs and TCPs) may be similar to those effects mentioned above for archaeological and historic built-environment resources, though none have been specifically identified during the current Project license period. General types of adverse effects that could occur on properties of religious and cultural significance within a similar environment include limited resource availability and restricted access to significant properties (Miller 2000). Changes in the auditory, atmospheric, and visual settings of a property of religious and cultural significance can adversely affect the character and viewshed of the property.

The assessment of Project-related adverse effects (direct and indirect) on historic properties for some portions of the Project Boundary, bypass reach, and fish and wildlife mitigation lands is pending the determination of the APE. In addition, studies proposed in support of relicensing will provide information that can be used to assess ongoing Project effects (see Section 5 of this PAD). Examples of the types of Project-related activities that can potentially affect historic properties include:

- **Changes in hydrology and geomorphology –** Can cause changes in aquatic habitat, directly affecting culturally-significant native species in terms of reduced resource availability. In addition, changes to downstream flows may cause direct effects from erosion and sedimentation, and changes in wetland and riparian areas, as well as indirect effects due to visual and landscape changes.
- **Maintenance of transmission lines** – May directly affect cultural resources through vegetation management and maintenance of lines, towers and roads, as well as indirectly through visual changes and auditory disturbances. In some areas, vegetation maintenance can foster the growth of berries and other early seral stage species that are culturally significant. In other areas, vegetation management can result in the establishment and spread of invasive species therefore reducing resource availability.

- **Maintenance modifications or upgrades –** Contributing historic resources could potentially incur adverse effects to historic character and integrity in the historic district of the Skagit River and Newhalem Creek Hydroelectric projects.

There are several one-time major maintenance/upgrade/replacement projects and proposed Project modifications that could potentially impact cultural resources (see Section 3.7). For example, the Diablo Tailwater Restoration Project could affect an area of particular cultural sensitivity to the Upper Skagit Indian Tribe. Consideration of TCPs or archaeological sites would be a part of this project.

4.10.6.2 Cumulative Effects

Cumulative effects on a resource are those that occur from adding an action's effects to the effects of other past, present, and reasonably foreseeable actions. Although the effects of a single action may be minor, the additive effects of multiple actions on the same resource can be significant.

No specific cumulative effects to cultural resources in the Project Boundary, bypass reach, and fish and wildlife mitigation lands have been identified. However, cumulative effects could occur when the Project-related effects are combined with activities or facilities managed or operated by other entities, such as the NPS or WSDOT. Examples of these other activities include recreation, road and trail maintenance, restoration, and emergency response. Additionally, cumulative effects related to erosion and sedimentation could occur along portions of the Skagit River within the Project Boundary, bypass reach, and fish and wildlife mitigation lands. The lands in the Project vicinity are managed by a number of agencies that may have different mandates and regulatory requirements.

Noise generated by NPS, Ross Lake Resort, visitors to the Project and surrounding areas, and vehicular traffic potentially contribute to auditory effects that impact cultural resources. Similarly, other infrastructure (e.g., transmission lines, transportation networks, and municipalities) in and adjacent to the Project vicinity would potentially contribute to visual effects. Cumulative effects may occur as the result of the Project-related effects combined with those of non-Project infrastructure and development, existing or proposed. Changes to snowpack, streamflow, vegetation profiles, and fire frequency and intensity resulting from climate change could combine with Project-related actions and result in cumulative effects on cultural resources in the Project vicinity.

4.10.7 Existing or Proposed Protection, Mitigation, and Enhancement Measures

4.10.7.1 Existing Measures

Existing PME measures for cultural resources under the current license are described in several cultural resources (archaeological and historic resources) and TCPs agreement documents which include:

- 1991 Cultural Resources Settlement Agreement (archaeological and historical) among City Light and the NPS, Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community (City Light 1991e). The agreement included expenditures for a cultural resources mitigation and management plan which included archaeological survey testing and evaluation of archaeological sites and preparation of the Skagit ARMMP and documentation, maintenance, protection and interpretive exhibits for historic building and engineering resources and included consultation and reporting requirements. As part of this agreement the City allocated an estimated total of $1,817,000 (in 1990$); $352,000 for historic resources and $1,465,000 for archaeological resources.

- 1991 HRMMP to fulfill FERC's request and comply with Section 106 of the NHPA and the implementing MOA were appended to the Settlement Agreement listed above (City Light 1991a). This MOA was among City Light, WA SHPO and NPS as concurring parties. City Light developed a similar MOA in 1993 to implement the ARMMP.
- 1991 TCPs Settlement Agreements (three separate agreements) between City Light and each of the tribes (Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, and Upper Skagit Indian Tribe)(City Light 1991b, c, d). These outlined the methods and compensation for completing inventories of TCPs, and for evaluating Project effects on those TCPs. The TCP settlement agreements provided for $1,079,169 in 1990$ to each tribe for cultural activities support, $154,167 for acquisitions of TCPs and $83,333 for TCP inventories. Funds were paid to the tribes between 1996 and 2000. In total, about $2.8 million in 2019$ was provided to each of the three tribes.
- 1991 TCPs MOAs (three separate agreements) between City Light and each of three tribes listed above to implement the TCP agreements adjusted allocated funds to account for inflation/deflation and provided for TCP acquisitions.
- 1993 Cultural Resources Settlement Agreement (archaeological and historical) between City Light and the Nlaka'pamux First Nation was similar to the 1991 Cultural Resources Settlement Agreement with the three U.S. tribes (City Light 1993). It included an update on development of and funding allocations for implementation of the Skagit ARMMP.
- 1993 TCPs Settlement Agreement between City Light and Nlaka'pamux Nation with the same methods, compensations and plans for TCP inventory and evaluating Project effects to TCP that were outlined in the 1991 TCP agreements with the three U.S. tribes. The Nlaka'pamux Nation was $500,000 in funding for cultural activities support and $100,000 for TCP inventory.
- 1994 Cultural Resources MOA among FERC, ACHP, NPS, Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, Upper Skagit Indian Tribe, and City Light to implement the 1991 Cultural Resources Settlement Agreement which included developing the Skagit ARMMP (City Light 1994). Another MOA signed the same year added the Nlaka'pamux Nation as signatory in order to implement the 1993 MOA with the Nlaka'pamux Nation. This MOA also included a Skagit Dams Construction/Indian Relations Study requested by FERC as part of the Cultural Resources Settlement Agreement. Phase 1 of the study included archival review and consultation, Phase 2 included interviews and the report (Larson and Forsman 2000), Phase 3 was a traveling interpretive exhibit that was displayed in towns near the tribal communities of the three affected U.S. tribes and in Seattle, completed in 2000. The focus was Indian and non-Indian relations at the time of and during construction of the Skagit River Project.
- 1996 Administrative MOA for TCPs among City Light, Sauk-Suiattle Indian Tribe, Upper Skagit Indian Tribe, and Swinomish Indian Tribal Community provided for administrative details to implement portions of the Skagit River Settlement Agreements concerning TCPs, specifically, making $98,750 available to each of the tribes as prime contractors to complete

the TCP studies and execute the 1994 Cultural Resources MOA with the these tribes (City Light 1996). The MOA outlined documentation and reporting requirements to fulfill NR Bulletin 38 for Evaluation and Documenting TCPs to determine the effect of the Skagit River Project operations on TCPs.

- 2010 Administrative MOA for TCPs between City of Seattle and Nlaka'pamux Nation (City Light 2010). Like the 1996 administrative agreement with the three U.S. tribes listed above, this agreement made funds available to the Nlaka'pamux Nation to complete a TCP study and determine effect of the Skagit River Project operations on TCPs. The majority of payment have been completed under this MOA.
- 2011 final Skagit ARMMP (amended in 2013; Schalk et al. 2013) in fulfillment of the Cultural Resources MOAs listed above. Since 2011, specific actions outlined in the Skagit ARMMP have been and continue to be implemented, including archaeological study (survey, monitoring, testing, data recovery) and supplemental studies, curation of collections, public interpretation, and tours for tribal members. This is a confidential document not publicly available.

One of the primary purposes of the Skagit ARMMP and HRMMP is to outline actions and processes to manage the historic properties within the Project Boundary under the current Project license. These management plans serve as a guide for City Light's operating personnel when performing necessary O&M activities, as well as identifying resource treatments to address potential ongoing and future effects to historic properties.

- **HRMMP –** The Skagit HRMMP provides policy direction and guidance for historic, architectural, and engineering resources associated with the Skagit River Project. The HRMMP is based upon the three sequential objectives of cultural resource management: identification of resources and evaluation of significance, protection of significant resources, and public interpretation of the resource base. The Skagit HRMMP provides guidance on preserving the historic resources that contribute to the district "Skagit River and Newhalem Creek Hydroelectric Projects." Historic preservation work is based on SOIS for the Treatment of Historic Properties and is tailored to the specific project.

  In addition to providing guidance on the treatment of historic resources the Skagit HRMMP includes specific mitigation measures and requires that City Light undertake or complete the following:

  - Training in preservation techniques of the Skagit personnel charged with maintaining the historic resources at the Skagit River Project – Conducted by City Light's historic resource specialist every two years.
  - A historic structures report for the Gorge Inn, Cambridge House, Garages #1-22 and House #222 – Completed by Tonkin/Hoyne Architects, Millegan/Jaddi Inc. and F. Letz for City Light, 1993-1995.
  - A historic landscape report for Ladder Creek Falls Garden – Completed by NPS, Cultural Resources Division for City Light, 1995.
  - An assessment of the Newhalem landscape – Completed by M. Tolon, NPS, Cultural Resources Division for City Light, 1994.

- Maintenance guidelines for historic structures at the Skagit – Completed by Tonkin/Hoyne Architects, Millegan/Jaddi Inc. and F. Lentz for City Light, 1992. Through coordination with the NPS additional specific guidance has been developed, e.g., the Skagit Color Handbook for approved paint colors updated in 2012.
- Computer, software and training for maintenance record keeping – Completed by City Light in 1997.
- A walking tour brochure for Newhalem – Completed in 1997, updated and reprinted as needed. This tour brochure was updated in 2011 and 2014.
- An interpretive exhibits program – The initial plan for this program focused on development of interpretive signs in Newhalem and new interpretive exhibits in the Newhalem Visitor Center (aka Skagit Information Center) and was completed in 1998. The plan was updated in 2014 to include Gorge Inn, Gorge Powerhouse and Diablo Powerhouse.
- New and updated interpretive exhibits – Over the current Project license, City Light has installed multiple new and updated interpretive exhibits at Project facilities and in Newhalem. New interpretive exhibits were installed at the RV parking area in Newhalem, the Gorge Powerhouse parking area, and in the Skagit Information Center in the early 2000s. Between 2010 and 2018, new displays and signage were installed in Ladder Creek Gardens, the Gorge Powerhouse Visitor Gallery and the newly renovated Gorge Inn. Two new signs were also added to the Ross Powerhouse boat dock. New exhibits for Diablo Powerhouse have been designed, with installation expected to occur in 2021-2022.
- Updates to the Skagit Tour Manual – Done annually, as needed.
- A HABS/HAER publication – Completed in 1998 with publication of "Skagit Power."
- Historic photographs conservation – Completed in 1995.
- Updates to the NRHP every 10 years – First update completed in 2010; next one scheduled for 2020.

Maintaining historic buildings in a remote area and meeting changing Project needs can be challenging and over the years, several historic properties at the Project fell into disrepair. In keeping with the intent of the Skagit HRMMP, City Light undertook major projects to rehabilitate the Gorge Inn in Newhalem and Ross Lodge in Diablo. Both projects were completed to the SOIS; with Ross Lodge receiving an award from the DAHP in 2014. The historic lights on Ladder Creek, which had stopped working in the 1970s, were replaced with LEDs in 2010 and are now programmed to illuminate the falls every night with portions of the trail and railings upgraded. Other major maintenance/rehabilitation work undertaken and guided by the HRMMP included rehabilitation of the historic houses in Diablo and Newhalem and the bunkhouses in Newhalem.

- **ARMMP** – The Skagit ARMMP guides the management, including mitigation, monitoring, protection, consultation, and conflict resolution for the Upper Skagit River Valley Archaeological District. The ARMMP also provides guidance for archaeological investigations related to survey, testing, and evaluation of archaeological sites. This guidance has been implemented throughout the current Project license period since the Skagit ARMMP was finalized. The Upper Skagit River Valley Archeological District is geographically restricted to modern-day Ross Lake and currently includes 16 contributing archaeological sites. The Skagit ARMMP included a requirement to conduct new aerial photography flights when Ross Reservoir was drawdown to a low level; these were conducted in 2018.

The Skagit ARMMP was reviewed and approved by the federally-recognized Indian tribes (Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community) that consulted for the relicense. It was also reviewed by the Nlaka'pamux Nation of Canada. NPS approved and SHPO concurred with the Skagit ARMMP. The ARMMP is a confidential document to protect site locations from looting, collecting and vandalism. Archaeological investigations have required federal archaeological permits in compliance with the ARPA.

Since approval of the Skagit ARMMP, archaeological data recovery projects have been funded and tracked by City Light and conducted by several professional archaeological contractors through coordination, permitting, consultation and direction of NPS. These projects have focused on sites eligible to the NRHP within the Upper Skagit River Archaeological District (DT00212) and are summarized in several confidential reports (Bush et al. 2007; Bush et al. 2008; Bush et al. 2009; Gerrish et al. 2018; Iversen et al. 2012; Iversen et al. 2013; Mierendorf 1993; Mierendorf and Weiser 2004; Mierendorf et al. 1998; Mierendorf et al. 2013; Nelson et al. 2018; Nelson et al. 2019).

4.10.7.2 Proposed Measures

As part of relicensing, City Light will update the Skagit ARMMP and HRMMP. Since their development, additional historic properties have been identified and new methodologies and techniques of management have become available.

The evaluation of the Project-related adverse effects on historic properties is pending the determination of the APE, field studies, and consultation. For those historic properties that would be adversely affected, where avoidance is not feasible, a mitigation treatment plan would be prepared by City Light. Any cultural resource that is considered unevaluated for listing in the NRHP would either be evaluated under the NRHP evaluation criteria or would be treated as a historic property (e.g., eligible) and included in the updated Skagit ARMMP or HRMMP or additional management plans, as applicable.

4.11 Tribal Resources

This section of the PAD describes tribal resources associated with the Skagit River Project. It also discusses any identified tribal resources that may be affected by continued operation of the Project under a new license. Recognizing that each federally-recognized tribe is in the best position to define their own rights and cultural or economic interests, this document is not intended to describe, characterize, or define the legally identified reserved rights of any individual tribe referenced herein.

The unique and distinctive political relationship between the U.S. government and Indian tribes is defined by treaties, statutes, executive orders, judicial decisions, and agreements, as discussed below (Indian Office 1902; Kappler 1972). This relationship has given rise to a federal trust responsibility, involving the legal obligations of the U.S. government toward Indian tribes, and the application of fiduciary standards of due care with respect to Indian lands, tribal trust resources, and the exercise of tribal rights (Newton 1982).

The treaties included a cession of land from the tribe to the U.S. and reservation by the tribe of certain lands and rights. The reserved rights vary by treaty, but generally include a portion of land for a homeland and/or hunting, fishing and gathering rights, both on and off the reservation (12 Stats. 927 1855 (Articles 2 and 5). Indian reservations were also formed by various executive orders, which are orders issued by the U.S. Executive office on the basis of authority specifically granted by the U.S. Constitution or a congressional act to the Executive branch. The executive orders that delineated the borders of and established Indian reservations were typically not negotiated with the affected tribes. Rather, the terms of executive orders were made on behalf of the tribes by the U.S. government and without formal consent of the tribes. All reservations share the same legal standing whether they were reserved by Congress, Treaty, or Executive Order.

There are intertribal agreements adjudicated by federal court in U.S. v Washington (384 F. Supp. 312, W. Dist. WA, (1974)). This Project will not impact or affect those intertribal agreements. Tribes exercise their Treaty rights independent of this Project.

The tribes that are signatories to the Point Elliott Treaty have adjudicated property rights to gather, hunt, and fish in the Project vicinity. The Project vicinity is defined as all lands within the Project Boundary, the bypass reach, and recently acquired or transferred fish and wildlife mitigation lands that are outside the current Project Boundary.

Those property rights have been adjudicated by federal courts in the US v. Washington litigation, and the US District Court for the Western District of Washington retains civil jurisdiction to adjudicate matters between the tribes themselves and the State of Washington. As part of its trust responsibility to Indian tribes, FERC will consult on its environmental documents and decisions (18 CFR § 2.1c) for the Project regarding potential impacts on reserved treaty rights of tribes (FERC 2019). Tribal resources refer to the collective rights and resources associated with a tribe's sovereignty or formal treaty rights, or their interest in and use of these resources. A natural resource is also one of traditional, cultural, and spiritual value. Tribal resources are located both on and off reservation lands and they may be used for commercial, subsistence, or ceremonial purposes. Tribal resources that are documented as archaeological and historic resources and properties of religious and cultural significance (including TCPs and TCLs) are discussed in Section 4.10 of this PAD. Fish and aquatics, plant, and wildlife species of special significance are discussed in Sections 4.5, 4.6, and 4.7, respectively.

4.11.1 Tribes with Federal Reserved Rights

4.11.1.1 Treaty of Point Elliott

The Washington Territory was organized on behalf of the United States in 1853. That same year, Joel Palmer, Superintendent of Indian Affairs for the Oregon Territory, and Isaac I. Stevens, Governor and Superintendent of Indian Affairs of the Washington Territory, were selected to represent Indian Policies for the Northwest. They met with representatives of a majority of the tribes in Western Washington and signed treaties during numerous councils.

At Point Elliott, Stevens met with the Duwamish, Suquamish, Snoqualmie, Snohomish, Lummi, Skagit, Swinomish (in order of signing), as well as other tribes on January 22, 1855 to sign a treaty. One of the Snoqualmie Indian chiefs signed in the name of the Stillaguamish, Snohomish, and Snoqualmie Indians (12 Stat. 971). The Treaty of Point Elliott was ratified later in 1859, guaranteeing both off-reservation fishing rights at all usual and accustomed (U&A) grounds and stations and the creation of reservations for the Suquamish, Tulalip, Swinomish, and Lummi tribes (12 Stat. 927 [1855]). As a result of the treaty, the tribes relinquished the majority of their lands. Reservations were not designated for the Duwamish, Skagit, Snohomish, and Snoqualmie tribes at this time.

The tribes' reserved rights were reaffirmed in 1974 (upheld 1979) during the United States vs. Washington court case that was named for trial court judge, George Hugo Boldt. This case, which became known as the Boldt Decision, reaffirmed the right of the Indian tribes in Washington State to co-manage salmon and other fish with the state, and also to continue harvesting fish in accordance with the various treaties (384 F. Supp. 312, W. Dist. WA, (1974)).[40] The reserved rights of the tribes to gather, hunt, and fish are both cultural and economic in nature.

4.11.1.2 Executive Orders

After treaty negotiations ended in 1871, the federal government established several reservations. The Colville Reservation was established on April 9, 1872 (with boundary revision on July 2, 1872), though the Columbia Band was not satisfied with the reservation (Boxberger 1996). Subsequently, the Columbia Reservation was established in 1879 for the Columbia, Methow, Entiat, Chelan, and Wenatchi bands and expanded in 1880; however, it was abolished in 1886 and the majority of the residents were removed to the Colville Reservation except for the holders of 37 allotments (Boxberger 1996). Since the reservations were established under Executive Orders and not treaties, off-reservation rights were not reserved. However, hunting and fishing rights were reserved for the Confederated Tribes of the Colville Reservation on the northern half of the reservation when it was ceded in 1892 (Colville Tribe 2019).

4.11.1.3 Federally-Recognized Indian Tribes

Several federally-recognized Indian tribes were identified who have tribal cultural or economic interests in the Project vicinity that may be affected by the Project relicensing. Based on their traditional tribal territories, these Indian tribes include the following:

- Upper Skagit Indian Tribe
- Sauk-Suiattle Indian Tribe
- Swinomish Indian Tribal Community
- Samish Indian Nation
- Stillaguamish Tribe of Indians
- Tulalip Tribes of Washington
- Snoqualmie Indian Tribe

[40] 384 F. Supp. 312 (W.D. Wash. 1974), aff'd, 520 F.2d 676 (9th Cir. 1975).

- Nooksack Indian Tribe
- Lummi Nation
- Confederated Tribes of the Colville Reservation

Tribes with reserved treaty rights include: Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, Samish Indian Nation, Stillaguamish Tribe of Indians, Tulalip Tribes of Washington, Nooksack Indian Tribe, and Lummi Nation (Boldt Decision). The Snoqualmie Tribe does not have adjudicated treaty rights but may have Section 106 interests (Bureau of Indian Affairs [BIA] 1999). The Confederated Tribes of the Colville Reservation does not have reserved off-reservation hunting and fishing rights in proximity to the Project Boundary.

None of the identified federally-recognized Indian tribes have reservations or trust lands directly within the Project Boundary (Figure 4.11-1). However, there are reservations on lands near the Project vicinity including (from north to south) the Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, Stillaguamish Tribe of Indians, and Tulalip Tribes of Washington. Off-reservation trust lands belonging to the Stillaguamish Tribe of Indians and Tulalip Tribes of Washington are also located near the Project vicinity (Figures 4.11-1). There are also Indian allotment parcels that are located in proximity to the Project vicinity.

In addition, FERC will consult with any tribe that attaches religious and cultural significance to historic properties that may be affected the Project NHPA (36 CFR § 800.2(c)(2)(ii). For context on historic properties, including archaeological and historic resources, and properties of religious and cultural significance, refer to Section 4.10 of this PAD.

4.11.2 First Nations

The term "First Nations" is used to refer to aboriginal peoples in Canada who are not Métis or Inuit.

There are two First Nations with cultural or economic interests in the Project vicinity:

- Nlaka'pamux Nation
- Stó:lō Nation

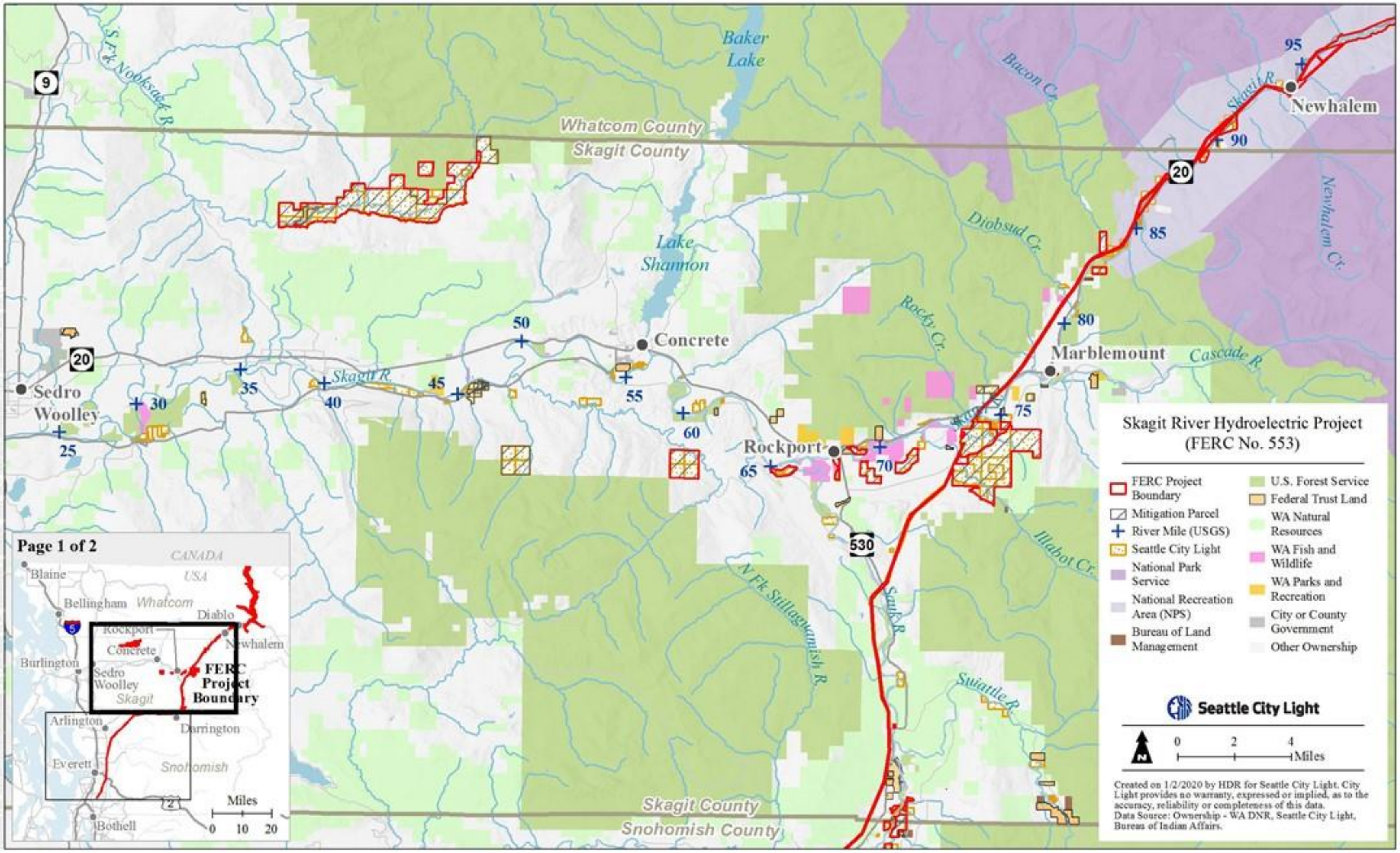


Figure 4.11-1. Federal trust lands in the Project vicinity (page 1 of 2).

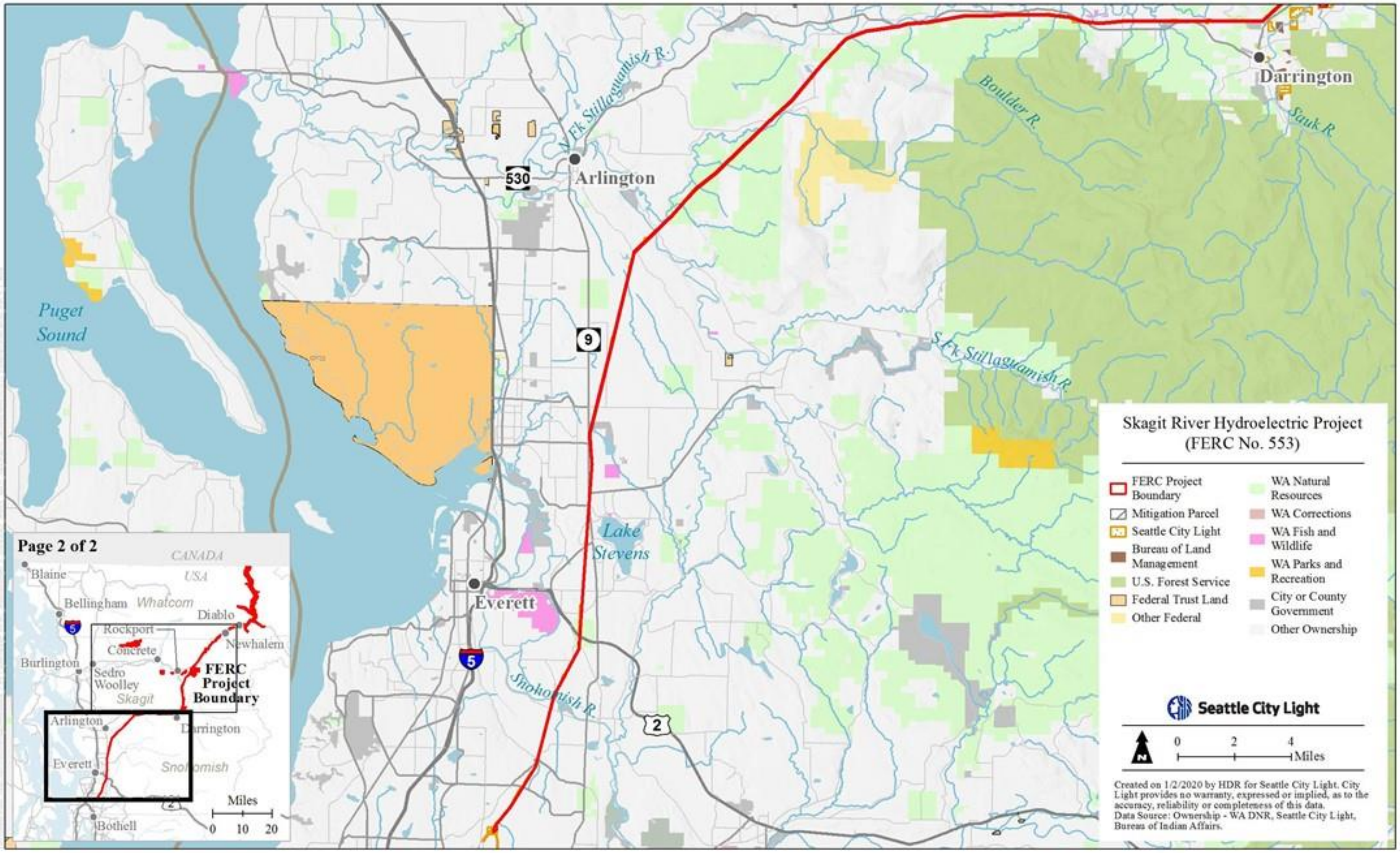


Figure 4.11-1. Federal trust lands in the Project vicinity (page 2 of 2).

4.11.3 Pre-Application Tribal Outreach

During 2019, City Light coordinated with LPs including the Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, and NPS regarding cultural resources to review current Project license implementation and identify issues to move forward into relicensing. City Light, tribal representatives, and other LPs met in bimonthly meetings to identify data gaps in the body of information gathered prior to or during the current Project license.

In addition, City Light held outreach meetings on October 10 and 15, 2019 to invite additional federally-recognized tribes with potential interest in the Project to review the scope and history of the Project. Invitations were sent to the Confederated Tribes of the Colville Reservation, Lummi Nation, Muckleshoot Indian Tribe, Nooksack Indian Tribe, Samish Indian Nation, Sauk-Suiattle Indian Tribe, Snoqualmie Indian Tribe, Stillaguamish Tribe of Indians, Swinomish Indian Tribal Community, Tulalip Tribes of Washington, and Upper Skagit Indian Tribe. The meetings served to introduce the existing Skagit River Project and the relicensing process.

City Light anticipates that FERC will initiate formal consultation under Section 106 of the NHPA and the NEPA for the Project relicensing and that FERC will designate City Light as its non-federal representative for carrying out informal consultation, pursuant to Section 106 of the NHPA. First Nations are not federally-recognized but can participate in the relicensing process.

Information concerning tribal resources and Project-related impacts on tribal resources will be identified in the FERC relicensing process.

4.11.4 Description of Tribal Resources

The term tribal resources is sometimes used narrowly to describe TCPs. However, in this document City Light has taken the broader view that tribal resources include TCPs as well as a suite of natural resources which are intertwined with the lifeways and cultural practices of tribes and First Nations. The ancestors of today’s federally-recognized Indian tribes and First Nations fished, hunted, and gathered in western Washington and the Project. Under the terms of the treaties, the federally-recognized Indian tribes continue to exercise these rights by fishing, hunting, plant gathering, and conducting cultural practices in their U&A areas, and on their ceded lands.

Many Indian tribes depend on traditional land-use activities and related natural resources, including wild, traditional foods from their ancestral homelands. Traditional cultural resources associated with cultural practices and beliefs of a living community are rooted in its history and are important in maintaining the continuing cultural identity of the community, and often, such properties are not quantifiable nor alienable. Identified TCPs can be evaluated through the NHPA guidance 36 CFR § 800 to identify and resolve adverse effects. For more detail regarding TCPs, consult the Cultural Resources section (see Section 4.10 of this PAD).

The Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community have expressed specific interests in the fish/aquatics and water quality in the Project vicinity. The Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, and Swinomish Indian Tribal Community currently operate commercial salmon and steelhead fisheries in the Skagit River (see Section 4.5 of this PAD). All three tribes also hunt on the Skagit River Project wildlife mitigation lands.

The following generalizations regarding potential tribal resources in the Project vicinity are based on ethnographic data. Fish species that were important to Indian tribes occur in the Project vicinity and include: salmon (Chinook, Coho, Sockeye, Chum, Pink), trout (Cutthroat, steelhead, Rainbow, Bull Trout), suckers, and bullhead (Blukis-Onat and Hollenbeck 1981; Miller 2017; Smith 1988). Important bird that may occur in the Project vicinity include: the common loon, mallard and other waterfowl, grouse, pheasant, coot, northern flicker (woodpecker), chickadees, and American robin, and various thrushes and sparrows (Miller 2017, 2019). Several ungulates that occur in the Project vicinity and are listed in ethnographic documents include black-tailed deer, elk, and moose (see Section 4.7 of this PAD; Miller 2019). Additional game animals include the mountain goat, which provide sustenance as well as wool, bear, hare, beaver, marten, and muskrat (Blukis-Onat and Hollenbeck 1981; Boxberger 1996; Miller 2017, 2019; Smith 1988). Plants with roots important to Indian tribes include camas, wapato, balsam (sunflower), lily, fern, wild carrot, potato, and wild onion (Blukis-Onat 1990; Blukis-Onat and Hollenbeck 1981; Gunther 1973; Miller 2019; Smith 1988). Important fruit-bearing plants include huckleberry, strawberry, salmonberry, raspberry, elderberry, gooseberry, currant, serviceberry, blackberry, and blueberries (Blukis-Onat and Hollenbeck 1981; Gunther 1973; Miller 2019; Smith 1988). Significant plants include cedar, fir, western hemlock, spruce, yew, tamarack, birch, juniper, vine maple, alder, pine, cascara, dogwood, willow, Indian plum, wild cherry, choke cherry, crab apple, hazelnut, pussy willow, wildrose, foxtail, and kinnikinnik (Blukis-Onat 1990; Blukis-Onat and Hollenbeck 1981; Gunther 1973; Smith 1988).

Additionally, the Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, Stillaguamish Tribe of Indians, and Snoqualmie Indian Tribe have all specifically expressed interest in the cultural resources locations in the Project vicinity. These interests have been conveyed throughout the current Project license period and during informal 2019 meetings that have occurred to date (see Section 4.11.3 of this PAD). As part of the current Project license, the Nlaka'pamux Nation expressed interest in cultural resources in the Project vicinity (see 4.11.3 of this PAD) and were included in the settlement agreement process. The Stó:lō Nation expressed an interest in the Project but were not included in settlement agreements based upon FERC's decision.

Further discussion of resources that may be considered tribal resources occurs in the following sections of the PAD:

- Fish and Aquatic Resources (4.5)
- Botanical Resources, Plant Species with Special Significance (4.6)
- Wildlife Resources, Wildlife Species with Special Significance (4.7)
- Recreation and Land Use, Regional Recreation Areas (4.8)
- Cultural Resources, Identified Historic and Archaeological Resources and Traditional Cultural Properties (4.10)

Studies proposed for fish, aquatic, plant, wildlife, and cultural resources as part of Project relicensing (as described in Section 5 of this PAD) will provide information regarding tribal resources and impacts on those resources.

4.11.5 Known or Potential Effects

This section describes known or potential Project-related and cumulative effects on tribal resources that may be associated with continued operation of the Project under a new license.

4.11.5.1 Project-Related Effects

No specific Project-related effects to tribal resources have been identified by the tribes to date.

City Light has identified the potential for culturally sensitive plant species to occur in the Project Boundary and fish and wildlife mitigation lands as a potential tribal resource issue (see Section 4.6.2 of this PAD). No formal list of such species has been obtained from any of the tribes to-date.

4.11.5.2 Cumulative Effects

No cumulative effects specifically related to tribal resources being evaluated for the Project relicensing have been identified at this time.

The nature and extent of any cumulative effects on tribal interests in such resources will be identified through the tribal consultation and resource studies that will be conducted as part of the relicensing process.

4.11.6 Existing or Proposed Protection, Mitigation, and Enhancement Measures

The potential need for PME measures related to tribal resources will be evaluated through the tribal consultation and resource studies that will be conducted as part of the relicensing process. City Light has implemented and continues to implement a number of existing PME measures focused on fish, aquatic, wildlife, botanical, and cultural resources as part of the current Project license and Settlement Agreements. These include:

- Fish and aquatic resources (see Section 4.5.6.1)
- Botanical and wildlife resources (see Sections 4.6.8.1 and 4.7.7.1)
- Archaeological resources (see Section 4.10.7.1)

4.12 Socioeconomic Resources

This section presents information on the socioeconomics, including land use patterns, population, and employment, of the Project vicinity and the State of Washington. All the Project’s generating facilities are in Whatcom County. The primary transmission lines cross through and the Project fish and wildlife mitigation lands are in Whatcom, Skagit, and Snohomish counties. Given that relatively little information exists on socioeconomics in the Project vicinity, this section relies on county data (when available) and state data.

4.12.1 Land Use and Real Estate

4.12.1.1 Land Use Patterns

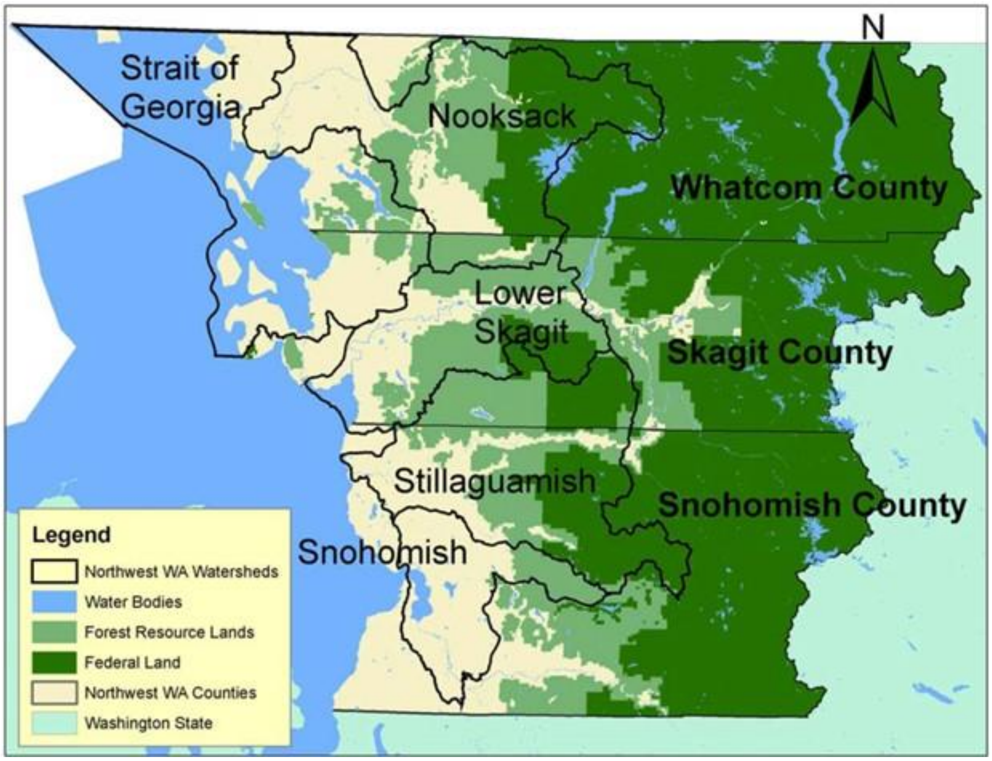
Lands within the Project Boundary include a mix of federal, state, county, and private lands, with most of the federal lands located north of Marblemount. Project generating facilities are entirely within the RLNRA. The Project transmission lines cross a mixture of public lands managed mostly by federal and state agencies, and private lands owned by City Light, individuals, corporations, and timber companies. Land uses adjacent to the transmission line include recreation, habitat conservation, forestry, rural residential, and small-scale agriculture. As the transmission lines get closer to the Bothell Substation, adjacent land uses also include suburban residential and transportation developments.

Federal lands constitute the vast majority of land in the eastern portions of Whatcom, Skagit, and Snohomish counties. Skagit County has the largest area of designated forest resource land (360,500 acres), followed by Snohomish County (254,400 acres), and Whatcom County (185,200 acres). The greatest total acreage of land, within the four northwest Washington watersheds, classified as designated forest land is within the Nooksack watershed (161,200 acres), and the least acreage is classified in the Snohomish watershed (30,400) (Table 4.12-1). As a percentage of total watershed area, the Snohomish watershed has the least land area classified as designated forest resource land (17 percent), and the lower Skagit watershed has the most (47 percent) (White undated). Figure 4.12-1 shows the designated forest resource lands and federal lands as identified in the current comprehensive plans for Whatcom, Skagit, and Snohomish counties.

Table 4.12-1. Acres of designated forest resource lands in four northwest Washington watersheds.

Watershed	Forest Resource Acres	Watershed Acres
Nooksack	161,200	498,000
Lower Skagit	134,000	284,000
Stillaguamish	160,400	438,000
Snohomish	30,400	177,000

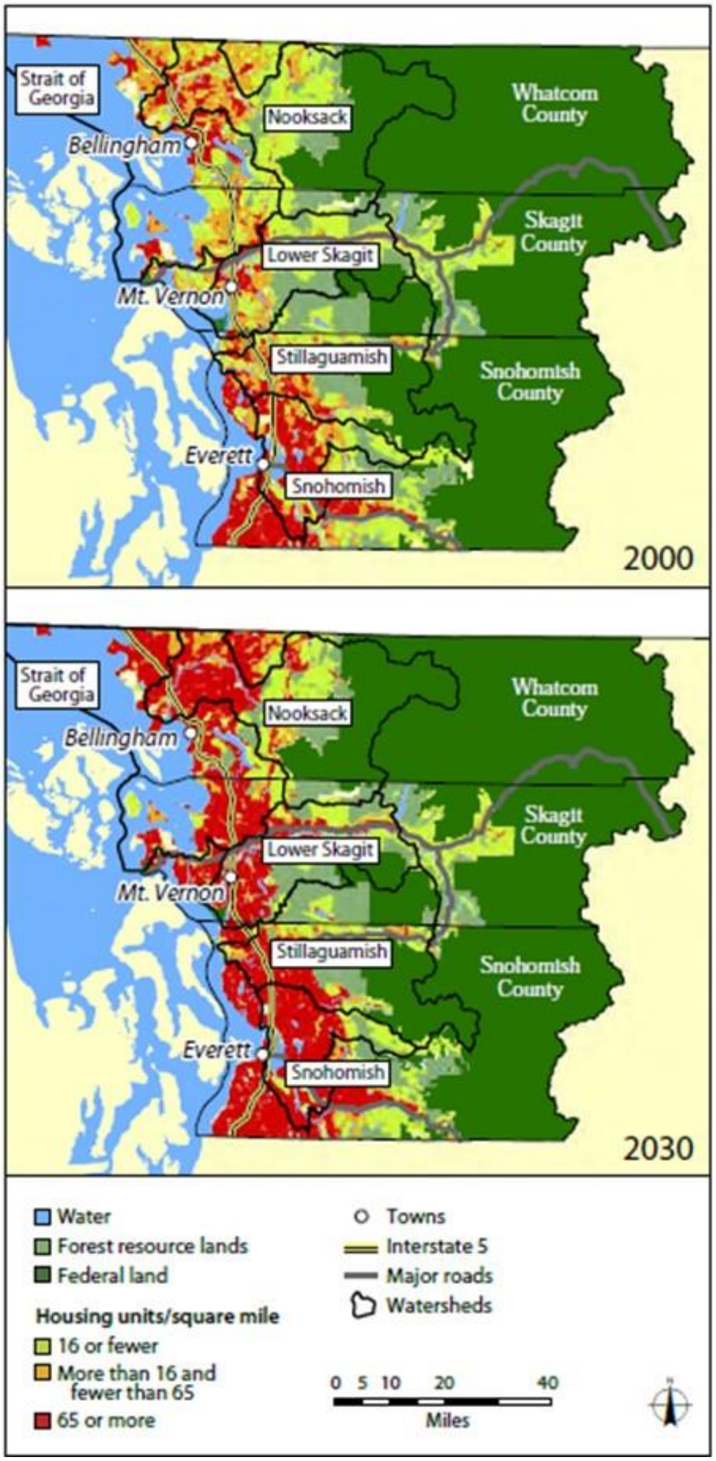
Source: White undated.



Source: Skagit County 2001; Snohomish County Planning and Development Services 2003; and Whatcom County Planning and Development Services 2005, as cited in White undated.

Figure 4.12-1. Designated forest resource lands and federal lands as identified in the current comprehensive plans of Whatcom, Skagit, and Snohomish counties.

Residential development levels differ considerably across the watersheds with the highest levels of residential development in the western portions. Of the northwestern Washington watersheds, the Snohomish watershed has the greatest concentration of residential development (White undated). Figure 4.12-2 shows the northwest Washington watersheds baseline housing unit density for the year 2000 and projections for 2030.



Source: Skagit County 2001; Snohomish County Planning and Development Services 2003; Theobald 2004, and Whatcom County Planning and Development Services, 2005 as cited in White 2008.

Figure 4.12-2. Year 2000 northwest Washington watersheds baseline housing unit density and projections for 2030 as identified for the USDA Forest Service "Forests on the Edge" project.

4.12.1.2 Population and Housing

The state population of Washington has increased approximately 10 percent between 2010 and 2018, with a total estimated population of 7,427,570 people (Office of Financial Management 2019). Whatcom County contains seven incorporated cities and 12 census designated places (WA HomeTownLocator 2019c) with a total estimated population of 220,350 (Office of Financial Management 2019). Skagit County contains four incorporated cities, four incorporated towns, and ten census designated places (WA HomeTownLocator 2019a) with a total estimated population of 126,520 (Office of Financial Management 2019). Snohomish County, which is immediately south of Skagit County, contains 18 incorporated cities, two incorporated towns, and 48 census designated places (WA HomeTownLocator 2019b) with a total estimated population of 805,120 (Office of Financial Management 2019).

The Skagit River Project is in a remote location and includes two small towns (Newhalem and Diablo) that provide the facilities and support services needed for Project O&M. Currently, about 25 of the 88 full-time employees who work at the Skagit River Project live in the two towns. Some of the houses are used as temporary lodging for contractors and City Light staff who normally work elsewhere and seasonal workers, others are rented to seasonal staff working for NPS and NCI. There are a few very small towns in the vicinity of the Project, mostly located along SR 20. Sedro-Woolley is the largest town closest to the Project and had a population of 10,540 in 2010 (U.S. Census Bureau [USCB] 2019a).

4.12.2 Demographics

4.12.2.1 Existing Population and Growth Trends

Population growth in Washington is mainly concentrated in the five largest metropolitan counties, but there has been growth in other metropolitan and nonmetropolitan counties as well. Seventy percent of Washington State’s population growth occurred in the five largest counties: King, Pierce, Snohomish, Spokane, and Clark. King County accounted for the largest share of state growth in 2018, at 31 percent, followed by Snohomish and Pierce at 13 and 11 percent, respectively. The state’s 18 nonmetropolitan counties accounted for 8 percent of population growth, which is up 3 percent from the previous year (Office of Financial Management 2018). Table 4.12-2 shows the estimated populations in Whatcom, Skagit, and Snohomish counties compared to Washington State’s population estimates from 2010 through 2018. Snohomish County is the most heavily populated of the three counties with Project facilities. Population has continued to increase over the years in all three counties. In 2018, the population of Whatcom County increased by 1.87 percent, 1.95 percent in Skagit County, and 1.99 percent in Snohomish County (Office of Financial Management 2018).

Table 4.12-2. Estimated populations in Washington State and Whatcom, Skagit, and Snohomish counties (2010-2018).[1]

Year	Washington State	Whatcom County	Skagit County	Snohomish County
2018	7,427,570	220,350	126,520	805,120
2017	7,310,300	216,300	124,100	789,400
2016	7,183,700	212,540	122,270	772,860
2015	7,061,410	209,790	120,620	757,600
2014	6,968,170	207,600	119,500	741,000
2013	6,882,400	205,800	118,600	730,500
2012	6,817,770	203,500	117,950	722,900
2011	6,767,900	202,100	117,400	717,000
2010	6,724,540	201,140	116,901	713,335

Source: Office of Financial Management 2019.

1 Whatcom County makes up approximately 3 percent of Washington State's population, while Skagit County and Snohomish County make up approximately 2 and 11 percent, respectively.

4.12.2.2 Age and Education Distributions

In 2010, the median age in all three counties ranged from 36.6 to 40.1. Approximately 12 percent of Washington State residents were age 65 or above in 2010, with 17.4 percent in Whatcom County, 20.7 percent in Skagit County, and 13.5 percent in Snohomish County.

Individuals with a high school education or higher are above the state percentage in Whatcom and Snohomish counties, while Skagit County is slightly below (Table 4.12.-3). Individuals with a Bachelor's Degree or higher are under the state's percentage for all three counties (USCB 2019b, c, d, e).

Table 4.12-3. Estimated education level in Washington State and Whatcom, Skagit, and Snohomish counties.[1]

Education Level	Washington State	Whatcom County	Skagit County	Snohomish County
High School Graduate or Higher	90.8%	92.3%	89.3%	91.9%
Bachelor's Degree or Higher	34.5%	33.8%	25.6%	31.3%

Source: USCB 2019b, c, d, e.

1 Values are based on persons age 25 years+ from 2013-2017.

4.12.2.3 Household and Housing Patterns

The average persons per household from 2013 to 2017 in Washington State was 2.55, with 82.4 percent living in the same house for more than one year; compared to 2.48 and 81.3 percent in Whatcom County, 2.53 and 83.8 percent in Skagit County, and 2.68 and 84.1 percent in Snohomish County (USCB 2019 b, c, d, e). Table 4.12-4 provides the estimated number of housing units in Washington State and the three counties. Single family houses are the most common type of housing and the number of single family houses has continued to increase steadily over the years. Housing growth in Washington State in 2018 increased by 7.5 percent over the previous year.

Washington state added 42,200 housing units in 2017, which was 2,900 more than 2016, but still lower than the prior decade annual average of 43,500 units (Office of Financial Management 2018).

Table 4.12-4. Estimated number of housing units in Washington State and Whatcom, Skagit, and Snohomish counties for 2010 and 2018.

Type of Housing	Washington State		Whatcom County		Skagit County		Snohomish County	
	2010	2018	2010	2018	2010	2018	2010	2018
One Unit	1,876,367	1,996,458	57,295	61,165	37,078	39,107	191,686	207,399
Two or More Units	759,497	872,634	22,766	25,674	7,913	8,291	75,546	85,367
Mobile Homes and Specials	249,813	256,521	10,604	10,823	6,482	6,576	19,427	19,566
Total Housing Units	2,885,677	3,125,613	90,665	97,662	51,473	53,974	286,659	312,332

Source: Office of Financial Management 2018.

4.12.2.4 Income Levels and Poverty Rates

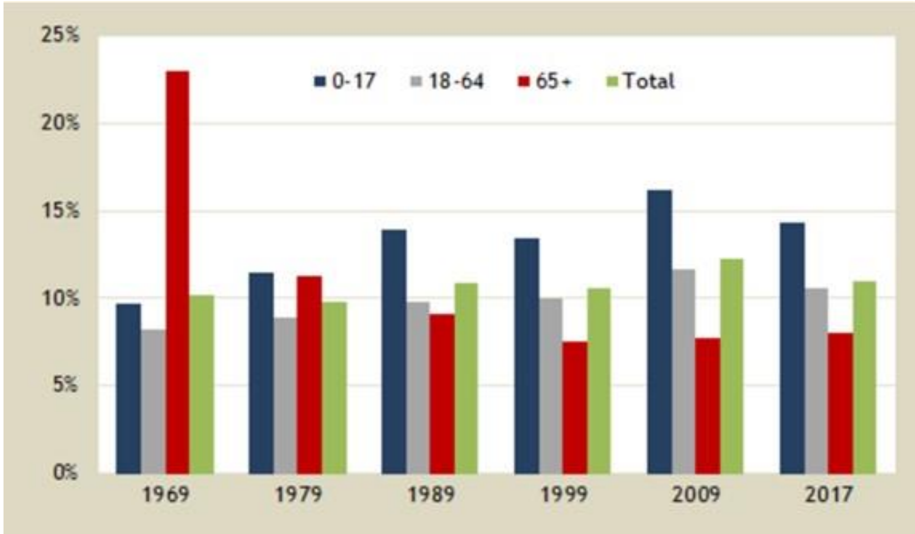
In general, the median household income in Washington State has continued to increase over the years. Table 4.12-5 shows the median household income estimates for the state and three counties in which the Project is located. In 2018, the projected median household incomes for Whatcom and Skagit counties was well below the state projected median income, while the projected median income for Snohomish County was significantly higher than the state average.

Table 4.12-5. Median household income estimates in Washington State and Whatcom, Skagit, and Snohomish counties.

Year	Washington State	Whatcom County	Skagit County	Snohomish County
2018[1]	$73,294	$64,681	$65,216	$85,758
2010	$54,888	$49,294	$54,426	$62,034
2000	$44,120	$37,044	$42,972	$50,870
1990	$33,417	$31,097	$30,181	$38,820

Source: Office of Financial Management 2019.
1 Values for 2018 are projections.

The statewide poverty rate for the total population of Washington State displayed almost no change over the 1990s, but spiked during the "great recession," which occurred from December 2007 through June 2009 (National Bureau of Economic Research 2019) (Figure 4.12-3). The only population group in Washington to show a significant long-term decline in poverty is the elderly. In 1969, 23.0 percent of the elderly, more than one in five, lived in poverty. By 2017, following national trends, this percentage dropped to 8 percent. The decrease in poverty among persons age 65 and over is due to the expansion of Social Security and Medicare benefits and adjusting benefits for inflation. Poverty rates increased for every other age group between 1999 and 2017 partially because of the severity of the recession and its lingering effects (Office of Financial Management 2019).



Source: Office of Financial Management 2019.

Figure 4.12-3. Washington State percent of population in poverty.

Families with children below the age of 18 living in poverty was lower than the state percentage in Whatcom and Snohomish counties and slightly higher in Skagit County (Table 4.12-6). The elderly population in poverty in all three counties was higher than the state percentage. The total number of individuals living in poverty was higher than the state percentage in Whatcom County, the same as the state percentage in Skagit County, and lower than the state percentage in Snohomish County.

Table 4.12-6. Percentage of population living in poverty in 2017.

Group	Washington State	Whatcom County	Skagit County	Snohomish County
Families with children under age 18	14.3%	11.1%	15.8%	8.2%
Individuals age 65 and older	8.0%	5.7%	6.4%	6.7%
All Individuals in Poverty	11.0%	13.1%	11.0%	7.1%

Source: Office of Financial Management 2019.

4.12.2.5 Race and Ethnicity

The largest population group in Washington State is non-Hispanic white persons, followed by Hispanic or Latino persons (Table 4.12-7). All racial and ethnic populations have increased substantially from 2000 to 2010 in the state and in all three counties.

Table 4.12-7. Race and ethnicity population figures in Washington State and Whatcom, Skagit, and Snohomish counties, 2000 and 2010.

2000	White		Black[1]		AIAN[2]		API[3]		Two or more races		Hispanic or Latino	
	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population
WA State	5,081,755	--	199,174	--	96,933	--	355,805	--	160,473	--	441,509	--
Whatcom County	152,325	3.0	1,245	0.6	4,825	5.0	5,017	1.4	3,414	2.1	8,687	2.0
Skagit County	97,001	1.9	500	0.3	2,021	2.1	1,813	0.5	1,644	1.0	11,536	2.6
Snohomish County	533,778	10.5	10,536	5.3	8,485	8.8	37,617	10.6	15,608	9.7	28,590	6.5

2010	White		Black[1]		AIAN[2]		API[3]		Two or more races		Hispanic or Latino	
	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population
WA State	5,535,262	--	252,333	--	122,649	--	535,190	--	279,106	--	755,790	--
Whatcom County	178,060	3.2	2,162	0.9	6,254	5.1	7,871	1.5	6,793	2.4	15,756	2.1
Skagit County	107,180	1.9	961	0.4	3,157	2.6	2,497	0.5	3,106	1.1	19,709	2.6
Snohomish County	585,558	10.6	19,130	7.6	11,121	9.1	67,988	12.7	29,538	10.6	64,249	8.5

Source: Office of Financial Management 2019.

1 Black = Black or African American

2 AIAN = American Indian or Alaska Native

3 API = Asian and Native Hawaiian and Other Pacific Islander

4.12.3 Industry and Employment

4.12.3.1 Local Industries and Major Employers

In 2016, Whatcom County had approximately 6,550 businesses (USCB 2019e). The County's largest job-providing sector is the private service-providing sector, making up about 61.2 percent of the total nonfarm employment in 2017 (Employment Security Department 2019c; Table 4-12.8).

Table 4.12-8. Top ten employers in Whatcom County, WA.

Company	Total Employees in 2017
St. Joseph Hospital	3,028
Lummi Nation	1,731
Western Washington University	1,700
Bellingham Public Schools	1,010
Whatcom County	907
BP Cherry Point	856
The City of Bellingham	853
Mayberry Packing LLC	805
Haggen	750
Fred Meyer	710

Source: Western Washington University (WWU) 2017b.

In 2016, Skagit County had approximately 3,457 businesses (USCB 2019b). The County's largest job-providing sector is the private service-providing sector, making up about 57 percent of the total nonfarm employment in 2017 (Employment Security Department 2019a; Table 4.12-9). As in Whatcom County, health care facilities employ the greatest percentage of Skagit County's jobs.

Table 4.12-9. Top ten employers in Skagit County, WA.

Company	Total Employees in 2017
Skagit Regional Health	1,802
Mount Vernon School District	998
Skagit Horticulture LLC (Formerly Skagit Gardens)	980
Skagit County Government	809
Janicki Industries	785
Sedro-Woolley School District	683
Island Hospital	568
Swinomish Casino	559
Draper Valley Farms	519
Shell Puget Sound Refinery	500

Source: WWU 2017a.

Snohomish County is home to over 20,500 businesses, ranging from small family farms specializing in organic foods, to the world's largest advanced manufacturing facility producing state-of-the-art aerospace equipment. Boeing is by far the county's largest employer. The 50 largest employers account for over 96,900 jobs, which is about 34 percent of the County's total employment (Economic Alliance Snohomish County 2019: Table 4.12-10).

Table 4.12-10. Top ten employers in Snohomish County, WA.

Company	Total Employees in 2018
The Boeing Company	35,000
Providence Regional Medical Center	4,906
Edmonds School District	3,616
The Tulalip Tribes	3,500
Washington State Government (includes colleges)	3,000
Naval Station Everett	2,900
The Everett Clinic	2,871
Snohomish County Government	2,759
Everett School District	2,443
Premera Blue Cross	2,200

Source: Economic Alliance Snohomish County 2019.

4.12.3.2 Employment by Industry

Whatcom County averaged 95,200 nonfarm jobs in 2018, with 76,400 of those jobs in service-providing industries and 18,800 of those jobs in goods-producing industries. The largest service-producing industry in the County is manufacturing, providing 10,400 jobs, and the largest goods-producing industry is private service, providing 58,200 jobs (Employment Security Department 2019c). According to the Census of Agriculture (2017c), there were 1,712 farms in Whatcom County, which is a one percent increase since 2012. Forty-one percent of sales from farms comes from crops and the other 59 percent is from livestock, poultry, and products (Census of Agriculture 2017c).

Skagit County averaged 51,300 nonfarm jobs in 2018, with 40,700 of those jobs in service-providing industries and 10,600 of those jobs in goods-producing industries. The largest service-producing industry in the County is manufacturing, providing 6,100 jobs, and the largest goods-producing industry is private service, providing 29,000 jobs (Employment Security Department 2019a). According to the Census of Agriculture (2017a), there were 1,041 farms in Skagit County, which is a three percent decrease since 2012. Sixty-seven percent of sales from farms comes from crops and the other 33 percent is from livestock, poultry, and products (Census of Agriculture 2017a).

Snohomish County averaged 291,100 nonfarm jobs in 2018, with 207,900 of those jobs in service-providing industries and 83,200 of those jobs in goods-producing industries. The largest service-producing industry in the County is manufacturing, providing 58,500 jobs, and the largest goods-producing industry is trade, transportation, and utilities, providing 48,600 jobs (Employment Security Department 2019b). According to the Census of Agriculture (2017b), there were 1,558 farms in Snohomish County, which is an eight percent increase since 2012. Forty-nine percent of sales from farms comes from crops and the other 51 percent is from livestock, poultry, and products (Census of Agriculture 2017b).

4.12.3.3 Tourism

NPS reported that in 2016, 979,578 visitors to the North Cascades National Park Service Complex, which includes Lake Chelan National Recreation Area, North Cascades National Park, and RLNRA, spent approximately $44,208,300 in communities near the parks. That spending supported 544 jobs in the local area and had a cumulative benefit to the local economy of $53,918,700 (NPS 2017).

National park tourism is a significant driver in the national economy, as well as a large factor in the local economy. According to the 2016 NPS report, park visitors spent most of their money on lodging (31.2 percent), followed by food and beverages (27.2 percent), gas and oil (11.7 percent), admissions and fees (10.2 percent), souvenirs and other expenses (9.7 percent), local transportation (7.4 percent), and camping fees (2.5 percent) (NPS 2017).

City Light has a long history of providing tours of the Project, which are offered during the summer season from June through September and attract visitors to RLNRA. City Light currently offers four types of guided tours and in 2019, over 4,700 people participated in the Skagit Tours. Over the past seven years, the most popular tour, the Diablo Lake Boat Tour, has averaged 2,306 visitors annually. The tours also create seasonal jobs. To conduct the tours City Light hires two tour guides, a boat captain, deckhand, and an extra cook for the season. Four additional tour guides and support staff are contracted through NCI and NPS. Additional information regarding Skagit Tours is provided in Section 4.8.2.1 of this PAD.

In partnership with NPS and City Light, NCI operates the ELC, which offers a variety of activities and programs for adults, teachers, and families. A summary of the types of programs available through the ELC as well as the number of participants in each program from 2014 through 2018 is provided in Table 4.12-11.

Table 4.12-11. Number of participants in programs available through the ELC (2014-2018).

Program	Number of Participants				
	2014	**2015**	**2016**	**2017**	**2018**
Adult and Family	1,542	1,422	1,845	2,003	1,935
Youth Leadership	164	87	77	92	79
Community	425	291	220	174	195
School Programs	2,781	2,798	3,219	3,268	4,265
Graduate	17	24	32	28	25
Conferences	1,174	650	999	1,057	800
Skagit Tours	2,494	1,589	4,048	4,807	4,966
Total	**8,597**	**6,861**	**10,440**	**11,429**	**12,265**

Source: NCI 2019.

The Ross Lake Resort is open from June through October and is the only lodging facility on Ross Lake. In addition to lodging, the resort rents fishing equipment, canoes, kayaks and motor boats, and operates a water taxi service to all major trailheads and camps along Ross Lake. The average annual overnight stays at Ross Lake Resort from 2014 through 2018 was 7,534. Table 4.12-12 provides the annual number of overnight stays for each year.

Table 4.12-12. Number of overnight stays at Ross Lake Resort (2014-2018).

Year	Number of Overnights Stays
2014	6,375[1]
2015	7,146
2016	7,949
2017	7,871
2018	8,328

Source: Hollis 2019.

1 There was no data for October.

4.12.3.4 Labor Force and Unemployment Rates

Whatcom County's 2018 resident civilian labor force averaged 111,596, with an unemployment rate of 4.7 percent. Within this estimate, 106,324 Whatcom County residents were counted among the employed and 5,272 were counted among the unemployed (i.e., active job seekers) (Employment Security Department 2019c).

During the latest period of recession and recovery, the peak unemployment rate in Whatcom County (11.1 percent) was observed in February 2010. The average unemployment rate that year was 9.5 percent. The unemployment rate has been falling slowly but consistently since then. Over the past year, the downward momentum of the unemployment rate has accelerated. As of November 2018 the unemployment rate in Whatcom County was 4.6 percent (Employment Security Department 2019c).

Skagit County's 2018 resident civilian labor force averaged 59,564, with an unemployment rate of 5.2 percent. Within this estimate, 56,441 Skagit County residents were counted among the employed and 3,123 were counted among the unemployed (i.e., active job seekers) (Employment Security Department 2019a).

Skagit County's unemployment rate tends to be higher than both the state and the nation in any given moment in time, but the overall trends track closely with the state. During the latest period of recession and recovery, the peak unemployment rate in Skagit County (13 percent) was observed in January 2010. Since reaching peak unemployment levels in 2010, the unemployment rate has generally been declining slowly. The dropping unemployment rate accelerated in 2017 and low rates were maintained throughout 2018; the lowest rate since before the recession was 4.4 percent in September 2018 (Employment Security Department 2019a).

The resident labor force in Skagit County is seasonal in nature, primarily due to the large and highly visible agricultural sector. Late every summer, the labor force swells and it contracts during off-peak seasons (Employment Security Department 2019a).

Snohomish County's 2018 labor force averaged 430,684, with an unemployment rate of 3.8 percent. Within this estimate, 414,469 Snohomish County residents were counted among the employed and 16,215 were counted among the unemployed (Employment Security Department 2019b).

During the latest period of recession and recovery, peak unemployment rates in Snohomish County were reached in early 2010, when rates reached 11.2 percent. The average unemployment rate for 2010 was 10.7 percent. Since 2010, the unemployment rate has been on a consistent downward trend through 2018 (Employment Security Department 2019b).

The unemployment rates in all three counties are higher than both the state and nation, which were 4.5 percent and 3.9 percent, respectively, in 2018. Skagit County has the highest unemployment rate at 5.2 percent for the three counties in which the Project is located (Employment Security Department 2019a, b, c).

Currently, City Light maintains a total of approximately 90 full-time employees at the Project. Additionally, 15-20 seasonal employees work at the Skagit River Project (Andersen 2019). Throughout the course of any given year there are a large number of transient City Light employees, consultants, and contractors working at the Project. The duration of time working at the Project varies greatly, from a few days, to weeks, or several months. Salaries paid to Skagit staff create secondary effects within the community as employees spend money at local establishments, such as restaurants and shops in the towns downstream of the Project in Whatcom, Skagit, and Snohomish counties.

4.12.4 Public Sector (Taxes and Services)

4.12.4.1 Taxes and Local Revenues

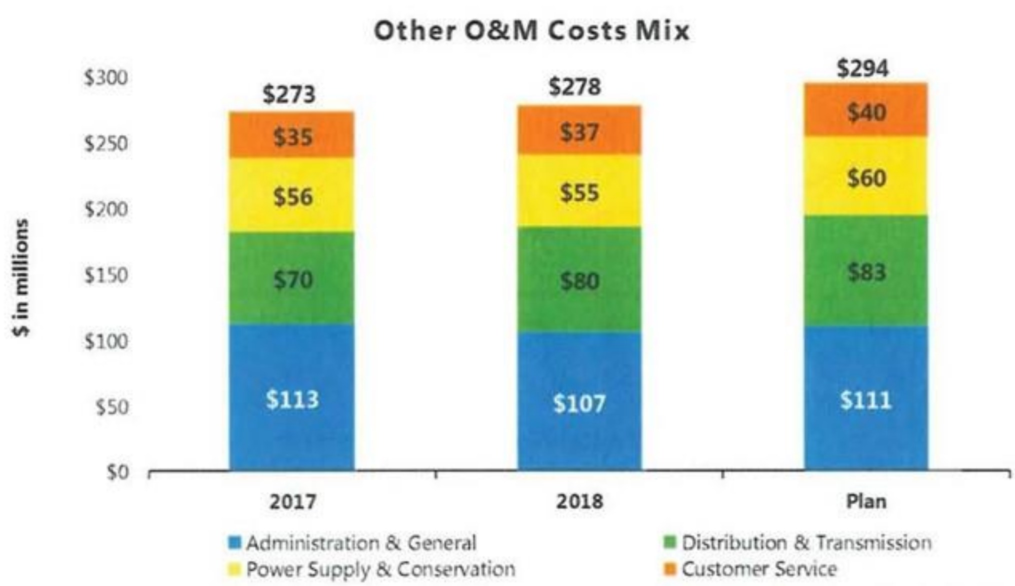
City Light's September 2018 monthly financial report indicated that retail power sales (gigawatt hours) through September were 0.9 percent lower than the 2018 Plan. Sales variances due to weather were estimated to be minor, as the significantly lower heating load in January was mostly offset by a higher heating load in other months. Retail power sales were forecasted for the remainder of the year and were expected to be 0.7 percent lower than the Plan for the full year. Retail revenue was expected to come in $6.1 million or 0.7 percent above the Plan. Figure 4.12-4 below shows the retail revenue (through September and forecasted through December) for 2018. In 2018, it was projected that City Light's Taxes and Debt Service would underspend by $5.7 million, due to lower than projected interest payments that were partially offset by higher tax payments (City Light 2018b).

Source: City Light 2018b.

Figure 4.12-4. Retail power revenue through September 2018 and forecasted through December 2018.

4.12.4.2 Expenditures on Services

O&M costs including (1) Administration and General, (2) Power Supply and Conservation, (3) Distribution and Transmission, and (4) Customer Service are $16.5 million or 5.6 percent under the Plan. These O&M costs are shown in Figure 4.12-5. The 2018 Plan was set using planning assumptions from City Light's adopted 2018 O&M budget. The forecast is lower than the budget largely due to approximately $10 million in spending reductions identified by City Light to help move towards its 1.80 debt service coverage goal. These reductions include labor savings (holding higher vacancy rates) and cuts to training, travel, and consulting services (City Light 2018b).



Source: City Light 2018b.

Figure 4.12-5. Actual and forecasted O&M costs for 2018.

4.12.4.3 City Light Contribution to Local Services

Per the 2009 Impact Payment Agreement between City Light and Whatcom County, City Light provides annual payments to Whatcom County according to the compensation methodology established in the previous agreement, which utilized the rate of taxation imposed under state law on the output of generation facilities of Public Utility Districts. Annual payments to Whatcom County from 2009 and through 2023 are detailed in Table 4.12-13.

Table 4.12-13. Annual payments from City Light to Whatcom County.

Year	Total Annual Payment
2009	$895,689
2010	$916,443
2011	$937,679
2012	$959,407
2013	$981,638
2014	$1,004,384
2015	$1,027,657
2016	$1,051,470
2017	$1,075,834
2018	$1,100,763
2019	$1,126,270
2020	$1,152,367
2021	$1,179,070
2022	$1,206,391
2023	$1,234,345
Total	**$15,849,406**

Source: City Light and Whatcom County 2009.

Whatcom County stations and pays all costs related to one deputy sheriff and one fully equipped, late model sheriff's law enforcement vehicle. The deputy sheriff's primary function is to provide general and emergency law enforcement services and responses in Newhalem and Diablo areas including, but not limited to City Light's Project facilities. City Light provides suitable housing in Newhalem to Whatcom County for the deputy sheriff. Whatcom County is responsible for the payment of reasonable rent and normal utility costs associated with the residence.

4.12.5 Electricity

The Skagit River Project supplies approximately 20 percent of City Light's power requirements to serve approximately 410,700 residential customers and over 50,000 non-residential customers (City Light 2018c). City Light's five largest industrial customers in 2018 were the University of Washington, NUCOR, Boeing, King County, and the Sabey Corporation.

4.12.5.1 Electricity Prices

As of March 2019, residential electricity rates in Washington State average 9.46 cents per kilowatt hour (kWh). This average electricity rate is 35.6 percent less than the national average residential rate of 12.83 cents per kWh (U.S. Energy Information Administration [USEIA] 2019).

As of March 2019, commercial electricity rates in Washington State average 8.88 cents per kWh. This average electricity rate is 17.6 percent less than the national average commercial rate of 10.44 cents per kWh (USEIA 2019).

As of March 2019, industrial electricity rates in Washington State average 5.24 cents per kWh. This average electricity rate is 28.4 percent less than the national average industrial rate of 6.73 cents per kWh (USEIA 2019).

City Light is a not-for-profit electric utility and electric rates are designed to recover the cost to serve its customers. City Light strives to keep electric costs as affordable as possible while ensuring that its customers receive fair, reliable, and green electric service. City Light's residential and general service electric rates are provided in Tables 4.12-14 and 4.12-15.

Table 4.12-14. City Light electricity prices for residential customers for 2019 and 2020.

	2019	2020
Base Service Charge per day	$0.1778	$0.1824
First Block per kWh[1]	$0.0902	$0.1004
End Block per kWh	$0.1326	$0.1326

Source: City Light 2019.

1 First 300 kWh monthly April through September, 480 kWh monthly October through March.

In addition to providing electrical service to the City of Seattle, City Light provides electrical service to several surrounding communities under franchise agreements. These communities include all or parts of Tukwila, Shoreline, Burien, SeaTac, and Lake Forest Park; rates differ among each of the communities.

4.12.5.2 Electricity Consumption

As of March 2019, electricity consumption in Washington State was 37,282,901 MWh annually for residential customers, 29,799,505 MWh for commercial customers, and 24,858,604 MWh for industrial customers.

Table 4.12-15. City Light electricity prices for small, medium, and large general service customers for 2019 and 2020.

	Small General Service City		Small Network General Service City		Small General Service Suburban		Medium General Service City		Medium Network General Service		Medium General Service Suburban		Large General Service City		Large Network General Service City	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Per kWh	$0.1003	$0.1057	$0.1003	$0.1057	$0.1003	$0.1057	$0.0765	$0.0811	$0.0925	$0.0992	$0.0765	$0.0811	--	--	--	--
Minimum Bill per Meter per Day	$0.39	$0.40	$0.39	$0.40	$0.39	$0.40	$1.23	$1.26	$1.23	$1.26	$1.23	$1.26	$29.11	$29.85	$29.11	$29.85
Per kWh Peak	--	--	--	--	--	--	--	--	--	--	--	--	$0.0869	$0.0919	$0.0979	$0.1050
Per kWh Off-Peak	--	--	--	--	--	--	--	--	--	--	--	--	$0.0580	$0.0612	$0.0653	$0.0699

4.12.6 Known or Potential Effects

4.12.6.1 Project-Related Effects

The presence of the Skagit River Project provides significant economic benefit to the regional economy. Existing available data indicate that development in the Project vicinity, mainly in the area along the Project's transmission line ROW, and throughout northwestern Washington State is growing and trends indicate that this will continue in the future. City Light strives to provide electricity to its customers at the most affordable rates possible; its electric rates are among the lowest in urban America (City Light 2018a). City Light and the Skagit River Project provide a valuable renewable energy resource in the region.

The Project provides approximately 110 jobs that in turn result in local business spending for goods and services. Local spending by City Light and its employees supports local businesses and generates additional sales tax revenues at the town and county levels, which helps local jurisdictions provide a wider range of services.

The Project also supports the local economy by fostering tourism. In addition, City Light provides recreational opportunities at and near the Project (including North Cascades ELC, the Gorge Inn Museum, Gorge Powerhouse Visitor Gallery, Ladder Creek Trail and Garden, and the Skagit Information Center) that attract visitors to the area. Visitors create demand for various support establishments, including hotels, restaurants, and recreation-based businesses. The reservoirs created by the Ross, Diablo, and Gorge dams of the Skagit River Project have created ideal places for some of these activities and bring tourists to the surrounding areas, which boosts local economies in northwestern Washington State.

City Light provides annual payments to Whatcom County per the 2009 Impact Payment Agreement as described in Section 4.12.4.3 of this PAD. Additionally, City Light provides suitable housing at the Newhalem site to Whatcom County for one deputy sheriff, whose primary function is to provide law enforcement services in the Newhalem and Diablo areas.

4.12.6.2 Cumulative Effects

No known or potential adverse cumulative effects on socioeconomic resources would occur as a result of the proposed relicensing of the Project. The values of the Project reservoirs, in conjunction with the values of the surrounding natural areas managed by NPS, combine to provide a cumulative benefit to the local economy, via the same mechanisms as those described for the Project alone (see preceding section).

4.12.7 Existing or Proposed Protection, Mitigation, and Enhancement Measures

City Light does not anticipate any adverse effects of the continued operation of the Project and is not proposing any PME measures related to socioeconomic resources.

5.0 PRELIMINARY ISSUES AND STUDIES

5.1 2019 Collaborative Issue Identification and Study Plan Development Process

In January 2019, City Light began a voluntary Collaborative Study Plan Development Process with LPs in preparation for initiating the formal relicensing process. The purpose of this early process was to provide a forum, a structure, and additional time to LPs with the goal of identifying resource issues that may warrant study during relicensing. The objectives were to: (1) develop a suite of agreed-upon issues and associated studies for inclusion in this PAD; (2) identify studies that could potentially be implemented early to allow more time to gather relevant information, and (3) review additional relevant information sources identified by LPs.

Over 20 organizations[41] participated in the Collaborative Study Plan Development Process, which consisted of a two-tier working group structure comprised of a policy-level Steering Committee and the following technical RWGs:

- Fish and Aquatic Resources Work Group (FARWG)
- Recreation and Aesthetic Resources Work Group (RARWG)
- Terrestrial Resources and Reservoir Erosion Work Group (TRREWG)
- Cultural Resources Work Group (CRWG)

The RWGs were comprised of LPs with technical expertise in applicable resource areas, while the Steering Committee was comprised of persons authorized by their organization to render decisions related to the environmental studies or other information collection activities under consideration by the RWGs. In addition, two subgroups were formed over the course of the process to focus on specific technical issues. The Steering Committee designated individuals to participate in a Fish Passage Subgroup and the FARWG set up a Geomorphology Subgroup. In total, the Collaborative Study Plan Development Process consisted of over 30 voluntary meetings in 2019 and through February 2020, as identified in Table 5.1-1.

[41] Organizations participating in the Collaborative Study Plan Development Process are identified in Section 7 of this PAD.

Table 5.1-1. Collaborative Study Plan Development Process meeting dates through February 2020.

Steering Committee Meeting Dates	CRWG Meeting Dates	FARWG Meeting Dates	RARWG Meeting Dates	TRREWG Meeting Dates	Geomorphology Subgroup Meeting Dates	Fish Passage Subgroup Meeting Dates
2/12/19	1/29/19	1/29/19	1/29/19	1/29/19	4/15/19	10/3/19
4/17/19	3/18/19	3/18/19	3/18/19	3/19/19	5/28/19	10/30/19
6/19/19	5/21/19	4/9/19	5/22/19	5/21/19	6/25/19	
9/4/19	8/7/19	5/20/19	7/31/19	7/30/19		
10/9/19	10/16/19	7/29/19		10/15/19		
11/6/19						
12/5/19						
1/23/20						

The Collaborative Study Plan Development Process provided LPs and City Light the opportunity to submit forms that identified a potential resource issue, its connection to the Project, information or studies requested, rationale for studying the issue, and how the information collected by the study could be used to support relicensing. Table 5.1-2 provides a summary of all the issue forms submitted in 2019 during this process. The Steering Committee reviewed all the issue forms and recommendations provided by the RWGs and either ratified the RWG recommendation for study of the issue or made a separate determination. The issues identified for study by the RWGs and Steering Committee were needed either to inform the relicensing or because of other agencies' mandates and a shared interest in the information by City Light. The following sections list the resource studies and management plans that are proposed by City Light to address issues identified as part of the Collaborative Study Plan Development Process and their associated goals and objectives.

Table 5.1-2. Summary of issue forms submitted in 2019 as part of the Collaborative Study Plan Development Process.

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
FA01	Study of Mitigation Outcomes	Effectiveness of PME measures implemented in the current Project license is unknown.	NCCC	▪ No study proposed; annual reports were provided. Existing information provided in this PAD.
FA02	Aquatic Invasive Species	Visitor attraction to Project facilities may increase the risk of colonization and establishment of AIS.	NPS	▪ No study proposed. Steering Committee agreed it would be appropriate to address issue with an AIS Management Plan (AISMP).
FA03	Recreational Fisheries	Project reservoirs provide increased access for angling, which may increases mortality rates on native fish.	NPS	▪ Food Web Study ▪ Recreation Use and Facility Assessment (RA-01S)
FA04	Fish Passage	Gorge, Diablo, and Ross dams block all upstream and impede downstream fish passage in the Skagit River.	NPS	▪ No study proposed at this time. Existing information is presented in this PAD and under discussion with LPs.
FA05	Water Temperature and Nutrient Levels	Project reservoirs interrupt invertebrate drift, nutrient and fine sediment flow, and alter nutrient cycling. Penstocks decrease water temperatures in the Project reservoirs and Skagit River below Gorge Dam.	NPS	▪ Water Quality Monitoring Study (FA-01S)
FA06	Non-native Fish	Project reservoirs and the dewatered Bypass Reach provide lentic habitat for non-native fish, which may increase risk to native fish species.	NPS	▪ Food Web Study
FA07	Fish Stranding	Reservoir drawdowns strand fish in Project reservoirs. Spill events likely strand fish in the Bypass Reach.	NPS	▪ Instream Flow Modeling (FA-02S) ▪ Reservoir Fish Stranding and Trapping Risk Assessment (FA-03S)
FA08	Productivity	Project operations prohibit the establishment of productive (natural) littoral and riparian communities.	NPS	▪ Food Web Study ▪ Reservoir Fish Stranding and Trapping Risk Assessment (FA-03S)

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
FA09	Littoral and Riparian Habitat	Project reservoir fluctuations may prevent the establishment of stable littoral and riparian habitats.	NPS	▪ Food Web Study ▪ Study of Sediment Deposition in Reservoirs Affecting Resources of Concern (GE-03S) ▪ Reservoir Fish Stranding and Trapping Risk Assessment (FA-03S) ▪ Special-Status Amphibian Study (TR-08S)
FA10	Reservoir Turbidity	Project reservoir drawdown events expose areas of bare soil that may be more prone to erosion, increasing the turbidity of Project reservoirs and the Skagit River.	NPS	▪ Water Quality Monitoring Study (FA-01S)
FA11	Spawning and Rearing Habitat	Reservoir operations inundate spawning and stream rearing habitat in the Upper Skagit Watershed and limit access to tributary habitat due to debris and shallow water.	NPS	▪ Food Web Study
FA12	Effective Spawning Habitat (ESH) Model	The Project currently utilizes a flow-habitat model to support a flow management program downstream of Gorge Powerhouse however, updated channel morphology and hydrology data are needed to ensure the flow-habitat model continues protection/enhancement of mainstem spawning salmon species and steelhead.	City Light	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S) ▪ Instream Flow Modeling (FA-02S)
FA13	Food Web	Changes in the aquatic environment due to the introduction of Redside Shiner, climate induced changes in hydrology, and other factors have resulted in a change in the fish community to characterize baseline condition necessary for relicensing.	City Light	▪ Food Web Study
FA14	Water Quality Monitoring	Project operations may be impacting water quality within the Project reservoirs and in the Skagit River downstream of the Project.	Ecology	▪ Water Quality Monitoring Study (FA-01S)
FA15	Water Quality Data	Existing water quality data collected for the Project is unknown and needs to be compiled.	Ecology	▪ Water Quality Monitoring Study (FA-01S)
FA16	Instream Flows – Bypass Reach	Project operations restrict flow into the Bypass Reach, which may have impacts on fish and other resources.	Ecology	▪ Instream Flow Modeling (FA-02S)
FA17	Instream Flows – Reservoirs and Tributaries	Project operations may impact instream flows for fish and other aquatic species in reservoirs and their tributaries.	Ecology	▪ City Light and Ecology to consult on available information, requirements, information gaps, and study elements.

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
FA18	Instream Flows – Downstream of Gorge	Project operations may impact instream flows for fish and other aquatic species downstream of Gorge Dam.	Ecology	▪ Instream Flow Modeling (FA-02S)
FA19	Geomorphology	Project operations may impact geomorphic processes that impact resources.	USFWS, NPS	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S)
FA20	Flood Control	The timing of flood storage availability may not be optimized for downstream flood risk management.	Skagit Drainage And Irrigation Districts Consortium	▪ Operations Modeling
FA21	Irrigation Flows	The Project does not manage flows to provide for uses such as irrigation, downstream of the reservoir.	Skagit Drainage And Irrigation Districts Consortium	▪ No study proposed. City Light to discuss issue with issue form proponents. Issue outside of relicensing.
FA22	Steelhead Density Dependence	This proposed project is to improve knowledge about habitat use and density-dependence in newly emerged steelhead fry and then use the data to determine whether those factors influence estimates of habitat capacity and spawner target goals.	NMFS, Trout Unlimited, WDFW	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S) ▪ Instream Flow Modeling (FA-02S)
FA23	Transmission Line Stream Crossing Habitat	Management of Project transmission lines have an unknown impact on aquatic ecosystem processes (riverine and floodplain) and quantifying these impacts to salmonid habitat is necessary.	Upper Skagit Indian Tribe, SRSC	▪ Study of Erosion and Geologic Hazards at Project Facilities and Transmission Line Corridor (GE-02S)
FA24	Floodplain Development	Project operations reduces floodplain inundation, which may be encouraging development and impacts to floodplain habitat.	Upper Skagit Indian Tribe	▪ Issue form dropped and resubmitted as FA36 and FA38.
FA25	Constructed Channel Salmonid Efficacy	Project operations alter flows in the Skagit River, which reduce peak flows that form and maintain off-channel habitat. Effectiveness (i.e., productivity) of constructed chum channels under current Project license is unknown.	SRSC	▪ RWG Hold. Issue to be discussed at the NCC.
FA26	Climate Change	Climate change may impact Project operations over the term of the next license.	NCCC	▪ Climate change considerations will be incorporated into studies as appropriate.
FA27	Beaver Floodplains and Dams	Project facilities and operations may impact the distribution and colonization of beavers in the Project area.	Upper Skagit Indian Tribe	▪ Resubmitted as TE22.

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
FA28	Dam Construction	The construction of original Project facilities may have resulted in on-going impacts that have not been mitigated under the current license.	Upper Skagit Indian Tribe	▪ No study proposed. To the extent there are on-going effects of Project operations, these will be analyzed during relicensing.
FA29	Fish Mortality Due to Entrainment and Spill	Project operations may cause possible injury and mortality to fish through entrainment and spill.	WDFW	▪ No study proposed. Existing information is provided in this PAD.
FA30	Fish Planting and Genetic Broodstock	Project operations impact fish and fish habitat, which has been mitigated by a fish stocking program, however the effects of rainbow genetic stock on lower river winter steelhead is unknown.	WDFW	▪ No study proposed. Elements potentially to be addressed outside of relicensing. Existing information is provided in this PAD.
FA31	Geomorphology in the Bypass Reach	Project operations may impact geomorphic processes in the bypass reach.	WDFW	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S)
FA32	Juvenile Monitoring	The juvenile salmon trap that estimates the abundance of salmon, steelhead, and Bull Trout is underfunded and requires additional partial funding for future project stability.	WDFW	▪ No study proposed. Program may be re-examined as a potential monitoring tool in the future license.
FA33	Juvenile Outmigration Flows	Project operations reduce the magnitude and change the timing of outmigration flows (which may not maximize juvenile outmigration) for salmonids from Gorge Dam to the Skagit River estuary.	WDFW	▪ Operations Modeling ▪ Instream Flow Modeling (FA-02S)
FA34	Large Woody Debris Survey	Project facilities and operations may reduce the amount of LWD in the Skagit River downstream of Gorge Dam.	WDFW	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S)
FA35	Process Flows	Project operations decrease the magnitude and number of geomorphic process flows in the Skagit River downstream of Gorge Dam.	WDFW	▪ Operations Modeling ▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S) ▪ Instream Flow Modeling (FA-02S)
FA36	Process Flow Constraints	Project operations impact flows downstream of Gorge Dam, which may change timing, duration, and/or frequency of floodplain inundation in the Skagit River.	Upper Skagit Indian Tribe	▪ Operations Modeling ▪ Instream Flow Modeling (FA-02S)
FA37	Ramping Rates	Project operations may result in downramping in the bypass reach and below the Project that may strand or entrap fish.	WDFW	▪ Instream Flow Modeling (FA-02S)

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
FA38	Regulatory Floodplain	Project operations may reduce the size of the regulatory floodplain, floodway, and channel migration zone in the Skagit River downstream of Gorge dam.	Upper Skagit Indian Tribe	▪ No study proposed. City Light does not have control over floodplain development, regulations, and flood control requirements. This is a Federal Emergency Management Agency (FEMA) and USACE responsibility to be addressed by those agencies during post-application consultations by FERC, if necessary.
FA39	Salmonid Limiting Factors	Project operations impact salmonid species, and the information necessary to evaluate limiting factors and population status/trends needs to be compiled.	Upper Skagit Indian Tribe	▪ No study proposed. Available limiting factors information is provided in this PAD.
FA40	Steelhead Habitat and Genes	Project operations may be impacting steelhead and their habitat in the Skagit River downstream of the Project and habitat and genetic information of steelhead needs compiled and analyzed.	WDFW	▪ No study proposed. Issue being considered by NCC for study under the current license.
FA41	Upstream Fish Passage and Fish Flows	Project operations do not allow for upstream fish passage through the bypass reach.	WDFW	▪ No study proposed at this time. Existing information is provided in this PAD and under discussion with LPs.
FA42	Ross Lake Woody Debris Management	Evaluate small woody debris management alternatives in Ross Reservoir.	City Light	▪ No study proposed. Issue to be addressed in a Ross Lake Woody Debris Management Plan.
FA43	Geomorphology from Gorge Powerhouse to Sauk River	Project operations may impact geomorphic processes downstream of Gorge Dam.	Geomorphology Subgroup	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S) ▪ Instream Flow Modeling (FA-02S)
FA44	Sediment Deposition within Reservoirs that Affect Resources of Concern	Project facilities and operations trap sediment in the reservoirs and may be impacting specific areas with resources of concern.	Geomorphology Subgroup	▪ Study of Sediment Deposition in Reservoirs Affecting Resources of Concern (GE-03S)
FA45	Bathymetry and Sediment Deposition within Reservoirs	Project facilities and operations trap sediment in the reservoirs and may be impacting recreation resources, cultural resources, lake ecosystems and power generation.	NPS	▪ Study of Sediment Deposition in Reservoirs Affecting Resources of Concern (GE-03S)

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
FA46	Project Effects on Skagit River Resources Downstream of the Sauk River	Project facilities and operations may have geomorphological impacts on the Skagit River downstream of the Sauk River.	NPS	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S) ▪ Instream Flow Modeling (FA-02S)
FA47	Sediment Budget and Storage, Stability, and Transport in Skagit River Downstream of Gorge Dam	Project facilities and operations block sediment from the Skagit River in the reservoirs.	NPS	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S)
FA48	Flood Coordination	Project operations may control flood events in the lower Skagit River basin and should be coordinated with local flood authorities.	Skagit Drainage and Irrigation District Consortium	▪ City Light to coordinate with issue form proponents to provide existing information and contacts to address issue.
TE01	Fire Suppression Model	Naturally ignited fires that start in the forests surrounding Project facilities are often suppressed to protect lives and property and may be impacting natural fire regime characteristics.	NPS	▪ No study proposed. Issue to be addressed in a Fire Management Plan.
TE02	Hazard Fuel Reduction	Wildfire fuels surrounding Project facilities create a risk to lives and property and may require treatment to reduce the risk.	NPS	▪ No study proposed. Issue to be addressed in a Fire Management Plan.
TE03	Littoral and Riparian Habitat	Project reservoir fluctuations may prevent the establishment of stable littoral and riparian habitats.	NPS	▪ Food Web Study ▪ Study of Reservoir Sediment Affecting Resources of Concern (GE-03S) ▪ Reservoir Fish Stranding and Trapping Risk Assessment (FA-03S) ▪ Special-Status Amphibian Study (TR-08S)
TE04	Study of Mitigation Outcomes	Effectiveness of mitigation measures implemented in the current Project license is unknown.	NCCC	▪ No study proposed; annual reports were provided. Information provided in this PAD.
TE05	Spotted Owl/Marbled Murrelet	Project facilities and operations may disturb the northern spotted owl and the marbled murrelet, which may lead to nest failures and population decline.	NPS	▪ Issue form dropped and resubmitted specific to marbled murrelet only.

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
TE06	Reservoir Erosion	Project operations may increase reservoir bank erosion and may impact recreational, cultural, and terrestrial resources.	NPS	▪ Reservoir Shoreline Erosion Assessment (GE-01S)
TE07	Shoreline Erosion	Project operations may increase reservoir shoreline erosion and may impact recreation, cultural, and terrestrial resources.	City Light	▪ Reservoir Shoreline Erosion Assessment (GE-01S)
TE08	Road and Townsite Erosion	Project operations and facilities may increase erosion and/or drainage issues and have the potential to affect terrestrial, aquatic, cultural and/or recreational resources.	City Light	▪ Study of Erosion and Geologic Hazards at Project Facilities and Transmission Line Corridor (GE-02S)
TE09	Vegetation Community Mapping and Characterization	Project operations impact terrestrial resources, however the effects to those resources is unknown.	City Light, NPS	▪ Vegetation Mapping Study (TR-01S)
TE10	Invasive Plant Survey	Project operations, Project related-recreation, and maintenance activities that bring in material or equipment from outside the Project area or that cause ground disturbance may contribute to the introduction and spread of invasive plants.	City Light, NPS	▪ Invasive Plants Study (TR-04S)
TE11	Rare Plant Study	Project operations may affect sensitive plants within the Project Boundary and RLNRA.	NPS	▪ Rare, Threatened, and Endangered Plants Study (TR-03S)
TE12	Wetland Functional Assessment	Project operations, Project-related recreation, and other land-disturbing activities may impact wetland communities.	NPS, USFS, City Light	▪ Vegetation Mapping Study (TR-01S) ▪ Wetland Assessment (TR-02S)
TE13	Goodell Creek Levee	A historic levee at Goodell Creek, built by City Light, may be impacting salmon spawning and rearing habitat and may be a source of contamination.	NPS	▪ No study proposed. To be addressed outside of relicensing.
TE14	Geologic Hazards	Landslides threaten Project facilities and operations, however an assessment of the threat of landslides may need to be updated.	NPS	▪ Study of Erosion and Geologic Hazards at Project Facilities and Transmission Line Corridor (GE-02S)
TE15	Roads and Drainage	Project transmission lines and roads may present the risk of landslides and threaten terrestrial and fish and aquatic habitat.	NPS	▪ Study of Erosion and Geologic Hazards at Project Facilities and Transmission Line Corridor (GE-02S)

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
TE16	Northern Goshawk	Project facilities and operations may cause nesting northern goshawks to abandon their nests, which may reduce the northern goshawk population.	WDFW	▪ Vegetation Mapping Study (TR-01S) ▪ Northern Goshawk Habitat Analysis Study (TR-07S) ▪ Project Operation Sound Assessment (RA-04S)
TE17	Marbled Murrelet	Project facilities and operations may disturb marbled murrelets, which may lead to nest failures and population decline.	NPS, USFWS	▪ Vegetation Mapping Study (TR-01S) ▪ Marbled Murrelet Study (TR-05S) ▪ Project Operation Sound Assessment (RA-04S)
TE18	Mitigation Lands Stewardship Plans	Project lands acquired to mitigate for the loss of wildlife habitat may not have adequate management plans to protect terrestrial resources.	Swinomish Indian Tribal Community, Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, SRSC	▪ No study proposed. Management plan for fish and wildlife mitigation lands will be developed.
TE19	Golden Eagle Breeding Area	Project operations and related activities may cause nesting eagles to abandon the nests, which may lead to population decline.	WDFW	▪ Vegetation Mapping Study (TR-01S) ▪ Golden Eagle Habitat Analysis Study (TR-06S)
TE20	Columbia Spotted Frog Survey	Project operations may reduce aquatic, littoral, and emergent vegetation needed for Columbia spotted frog habitat.	WDFW	▪ Special-Status Amphibian Study (TR-08S)
TE21	Loon Nesting and Brood Rearing	Project operations may reduce aquatic, littoral, and emergent vegetation and may degrade breeding and brood rearing habitat for loons.	WDFW	▪ RWG determined no study plan was required.
TE22	Beaver Floodplains and Dams	Project facilities and operations may impact the distribution and colonization of beavers in the Project area.	Upper Skagit Indian Tribe	▪ Vegetation Mapping Study (TR-01S) ▪ Beaver Habitat Assessment (TR-09S)
TE23	Pollinators and Native Plant Restoration in Transmission Line Corridor	Project operations may reduce the pollinator habitat in the North Cascades.	SEEC	▪ No study proposed. Vegetation management plan to address opportunistic planting opportunities for pollinators.

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
RA01	Recreation and Visitor Use	Information necessary to evaluate Project recreation opportunities, facilities, and visitor use is inadequate to guide the development of a Project recreation management plan.	NPS	▪ Recreation Use and Facility Assessment (RA-01S)
RA02	Recreation Inventory	Information necessary to evaluate Project recreation opportunities, facilities, and visitor use is needed to guide the development of a Project recreation management plan.	City Light	▪ Recreation Use and Facility Assessment (RA-01S)
RA03	Study of Mitigation Outcomes	Effectiveness of mitigation measures implemented in the current Project license is unknown.	NCCC	▪ No study proposed; annual reports were provided. Information provided in this PAD.
RA04	Whitewater Recreation	Project operations and facilities impact whitewater recreation in the Skagit River, and the whitewater feasibility of the bypass reach is unknown.	American Whitewater	▪ Gorge Bypass Reach Safety and Whitewater Boating Assessment (RA-02S)
RA05	Night Sky	Project facilities and operations may be a source of light pollution for North Cascades National Park and RLNRA.	NPS	▪ Project Facility Lighting Inventory (RA-03S)
RA06	Soundscapes	Noise generated by Project facilities and operations may interfere with visitor experiences at RLNRA.	NPS	▪ Project Operation Sound Assessment (RA-04S)
RA07	Noise	Noise generated by Project facilities and operations may impact cultural, wildlife, and recreation resources.	City Light	▪ Project Operation Sound Assessment (RA-04S)
RA08	Property Inventory	A comprehensive inventory of buildings and infrastructure within the Project Boundary and RLNRA is incomplete and needs to be developed.	NPS	▪ Recreation Use and Facility Assessment (RA-01S)
RA09	Climbing Management	Access to City Light property near NPS climbing management areas is closed for recreational climbing.	Access Fund	▪ No study proposed. City Light and NPS to discuss management responsibilities during relicensing.
RA10	Visitor Use Impacts	Project facilities and operations that provide opportunities for recreation may impact resources within the Project Boundary and RLNRA.	NPS	▪ Recreation Use and Facility Assessment (RA-01S)
CR01	Data Synthesis Study	Baseline cultural resources data within the Project Boundary has not been collected or synthesized.	City Light	▪ Cultural Resources Data Synthesis Study (CR-01S)
CR02	Erosion Monitoring Plan	Ross Lake reservoir operations may concentrate erosion near the shoreline causing the removal of in situ archaeological remains.	NPS	▪ No study proposed. Issue to be addressed in a Ross Lake Cultural Resources Erosion Management Plan.

Issue ID	Title of Issue Form	Summary of Issue	Submitted By	Study(s) that Addresses this Issue Form or Status of Issue[1]
CR03	Preliminary Definition of APE	The effects of Project operations to cultural resources are incompletely understood or unresolved. An APE was not established for the current license and a new APE will need to be established for the relicensing.	Upper Skagit Indian Tribe	▪ APE will be developed during the formal relicensing process.
CR04	Survey of APE	Project operations may affect cultural resources, and survey is necessary, as required by Section 106 of the NHPA.	Upper Skagit Indian Tribe	▪ Cultural Resources Survey (CR-02S)
CR05	Study of Mitigation Outcomes	Effectiveness of PME measures implemented in the current Project license is unknown.	NCCC	▪ No study plan required; annual reports were provided. Information provided in this PAD.
CR06	Bypass Reach Survey	The bypass reach has not been comprehensively surveyed and an inventory is necessary to identify and evaluate any historic properties that may exist within this portion of the APE.	NPS	▪ Gorge Bypass Reach Cultural Resources Survey (CR-03S)
CR07	Ross Lake Geomorphology Study and Monitoring	Project operations may impact geomorphic processes that impact cultural resources near Ross Lake.	City Light, NPS	▪ No study proposed. Issue to be addressed in a Ross Lake Cultural Resources Erosion Management Plan.
CR08	Downstream Geomorphology	Project operations may impact geomorphic processes that impact cultural resources downstream of Gorge Dam.	NPS	▪ Gorge Dam to Sauk River Geomorphology Study (GE-04S)
CR09	Transmission Line Auditory Effects	The noise produced by the Project transmission line may impact cultural resources.	Sauk-Suiattle Indian Tribe	▪ Project Operation Sound Assessment (RA-04S)
CR10	Unauthorized Visitation Effects	Project operations may increase unauthorized visitation and damage to sensitive cultural resource sites.	Upper Skagit Indian Tribe	▪ Issue form held at RWG. City Light to work with NPS on managing visitation at the site.

1 The proposed studies identified will provide information to assist in addressing the issues identified in the issue forms; however, the proposed study plans will not address every element of every issue form. Details to be discussed during study plan development in 2020.

5.2 Baseline Studies

Prior to the Collaborative Study Plan Development Process in 2019, City Light initiated two baseline studies based on discussions with LPs involved in current license compliance. City Light contracted with NPS to conduct a Landform Mapping Study and with the USGS to conduct a Food Web Study.

The MOA for the Landform Mapping Study is appended to this PAD. This study will provide a baseline map of land and channel forms within the channel migration zone of the Skagit River. The scope of work for the Factors Limiting Native Salmonids above Skagit River Dams ("Food Web Study") also is appended to this PAD. The results of these studies will be available to inform the relicensing process.

5.3 Study Plan Development

While acknowledging the interests of other LPs, City Light determined that many of the issue forms submitted as part of the Collaborative Study Plan Development Process requested information that would not be necessary to inform the license application. City Light determined that many issues could be analyzed with existing information, would be sufficiently informed by another study, or were not relevant to relicensing. City Light developed 24 study proposals to address issues that the Steering Committee agreed should be studied during relicensing (Table 5.3-1). Three of the proposed studies are considered additional baseline studies that will be used to inform other studies, and warrant early implementation in 2020. Several resource issues identified in the Collaborative Study Plan Development Process could be addressed by a management plan without the need for a resource study, and those are identified in Section 5.4 of this PAD.

This section provides summaries of City Light's goals, objectives, geographic scope, and methods for each of the 24 proposed study plans. The proposed studies generally are focused within the Project Boundary and fish and wildlife mitigation lands. While in the Project Boundary, lands associated with the inundation zone of High Ross are not impacted by current operations and therefore anticipated to be excluded from the geographic scope of the proposed relicensing studies.

Full draft study plans for the three studies to be implemented early are appended to this PAD. The other 21 draft study plans will be provided for review and comment to LPs between March and July 2020. City Light intends to file its Proposed Study Plan (PSP) package with FERC in October 2020. Prior to any fieldwork on the proposed studies, applicable state and federal permits will be obtained.

The results of the 24 proposed studies, combined with the two ongoing baseline studies and the extensive existing information summarized in Section 4 of this PAD, will be used to support a comprehensive analysis of resources and will inform development of PME measures in the license application.

Table 5.3-1. Proposed studies and issue form(s) addressed.

Study No.	Study	Issue Form(s) Addressed by this Study[1]
Operations Model	Operations Modeling	▪ FA20 – Flood Control ▪ FA33 – Juvenile Outmigration Flows ▪ FA35 – Process Flows ▪ FA36 – Process Flow Constraints
GE-01S	Reservoir Shoreline Erosion Assessment	▪ TE06 – Reservoir Erosion ▪ TE07 – Shoreline Erosion
GE-02S	Study of Erosion and Geologic Hazards at Project Facilities and Transmission Line Corridor	▪ FA23 – Transmission Line Stream Crossing Habitat ▪ TE08 – Road and Townsite Erosion ▪ TE14 – Geologic Hazards ▪ TE15 – Roads and Drainage
GE-03S	Study of Sediment Deposition in Reservoirs Affecting Resources of Concern	▪ FA09 – Littoral and Riparian Habitat ▪ FA44 – Sediment Deposition within Reservoirs that Affect Resources of Concern ▪ FA45 – Bathymetry and Sediment Deposition within Reservoirs ▪ TE03 – Littoral and Riparian Habitat
GE-04S	Study of Skagit River Geomorphology Between Gorge Dam and the Sauk River	▪ FA12 – ESH Model ▪ FA19 – Geomorphology ▪ FA22 – Steelhead Density Dependence ▪ FA31 – Geomorphology in the Bypass Reach ▪ FA34 – Large Woody Debris Survey ▪ FA35 – Process Flows ▪ FA43 – Geomorphology from Gorge Powerhouse to Sauk River ▪ FA46 – Project Effects on Skagit River Resources Downstream of the Sauk River ▪ FA47 – Sediment Budget and Storage, Stability, and Transport in Skagit River Downstream of Gorge Dam ▪ CR08 – Downstream Geomorphology
FA-01S	Water Quality Monitoring	▪ FA05 – Water Temperature and Nutrient Levels ▪ FA10 – Reservoir Turbidity ▪ FA14 – Water Quality Monitoring ▪ FA15 – Water Quality Data
FA-02S	Instream Flow Model	▪ FA07 – Fish Stranding ▪ FA12 – ESH Model ▪ FA16 – Instream Flows – Bypass Reach ▪ FA18 – Instream Flows – Downstream of Gorge ▪ FA22 – Steelhead Density Dependence ▪ FA33 – Juvenile Outmigration Flows ▪ FA35 – Process Flows ▪ FA36 – Process Flow Constraints ▪ FA37 – Ramping Rates ▪ FA43 – Geomorphology from Gorge Powerhouse to Sauk River ▪ FA46 – Project Effects on Skagit River Resources Downstream of the Sauk River
FA-03S	Reservoir Fish Stranding and Trapping Risk Assessment	▪ FA07 – Fish Stranding ▪ FA08 – Productivity ▪ FA09 – Littoral and Riparian Habitat ▪ TE03 – Littoral and Riparian Habitat

Study No.	Study	Issue Form(s) Addressed by this Study[1]
TR-01S	Vegetation Mapping	▪ TE09 – Vegetation Community Mapping and Characterization ▪ TE12 – Wetland Functional Assessment ▪ TE16 – Northern Goshawk ▪ TE17 – Marbled Murrelet ▪ TE19 – Golden Eagle Breeding Area ▪ TE22 – Beaver Floodplains and Dams
TR-02S	Wetland Assessment	▪ TE12 – Wetland Functional Assessment
TR-03S	Rare, Threatened, and Endangered Plant Study	▪ TE11 – Rare Plant Study
TR-04S	Invasive Plants Inventory	▪ TE10 – Invasive Plant Survey
TR-05S	Marbled Murrelet Study	▪ TE17 – Marbled Murrelet
TR-06S	Golden Eagle Habitat Analysis Study	▪ TE19 – Golden Eagle Breeding Area
TR-07S	Northern Goshawk Habitat Analysis Study	▪ TE16 – Northern Goshawk
TR-08S	Special-Status Amphibian Study	▪ FA09 – Littoral and Riparian Habitat ▪ TE03 – Littoral and Riparian Habitat ▪ TE20 – Columbia Spotted Frog Survey
TR-09S	Beaver Habitat Assessment	▪ TE22 – Beaver Floodplains and Dams
RA-01S	Recreation Use and Facility Assessment	▪ FA03 – Recreational Fisheries ▪ RA01 – Recreation and Visitor Use ▪ RA02 – Recreation Inventory ▪ RA08 – Property Inventory ▪ RA10 – Visitor Use Impacts
RA-02S	Gorge Bypass Reach Safety and Whitewater Boating Assessment	▪ RA04 – Whitewater Recreation
RA-03S	Project Facility Lighting Inventory	▪ RA05 – Night Sky
RA-04S	Project Operation Sound Assessment	▪ TE16 – Northern Goshawk ▪ TE17 – Marbled Murrelet ▪ RA06 – Soundscapes ▪ RA07 – Noise ▪ CR09 – Transmission Line Auditory Effects
CR-01S	Cultural Resources Data Synthesis Study	▪ CR01 – Data Synthesis Study
CR-02S	Cultural Resources Survey	▪ CR04 – Survey of APE
CR-03S	Gorge Bypass Reach Cultural Resources Survey	▪ CR06 – Bypass Reach Survey

1 The proposed studies identified will provide information to assist in addressing the issues identified in the issue forms, however the proposed studies will not address every element of every issue form. Details to be discussed during study plan development in 2020.

5.3.1 Operations Model

5.3.1.1 Summary of Issue

Several issues raised by LPs in 2019 during the Collaborative Study Plan Development Process indicate the need to evaluate the effects of current Project operations on a variety of resource areas. Any modifications to current operations may affect reservoir storage and surface elevations, streamflows, and hydroelectric power generation. The trade-offs between numerous, and potentially competing, alternative operating requirements can be quantified by the use of a calibrated and validated Operations Model. The Operations Model can determine if a potential alternative is feasible, answering questions such as "are inflows and reservoir storage sufficient to support a specific streamflow requirement?" The Operations Model will be able to quantify the effects of multiple requirements on the system and identify the competing/conflicting issues with a proposed alternative. Outputs from the Operations Model may include but not be limited to the assessment of aquatic habitat protection, geomorphic process flows, fish flows (e.g., outmigration flows), recreational interests, and power generation.

The Operations Model will provide direct or supporting information for decision-making related to the following issues, as well as those identified in many of the issue forms submitted by LPs in 2019 during the Collaborative Study Plan Development Process (see Table 5.1-2):

- Reservoir storage/refill/outflows/flood control
- Reservoir water surface elevation fluctuation (habitat, recreation, navigation)
- Resulting elevations (available flood storage, recreation targets met)
- Generation by loadshape period

5.3.1.2 Goals and Objectives of Study

The goal of this study is to develop an Operations Model that represents Project operations and may be used to evaluate how alternative operational scenarios affect predicted reservoir elevations, generation, and outflows for each of the Project dams and reservoirs under various operational constraints (e.g., minimum flow, reservoir level, and hydrology). Specifically, for each Project reservoir, the model will use historical and projected future hydrology to predict reservoir outflow, reservoir elevations, surface areas, and corresponding Project generation at an hourly time-step. An additional objective of this study is to support requests from LPs to assess alternative operational scenarios proposed during relicensing.

5.3.1.3 Geographic Scope

The scope of the Operations Model is the geographic region of the Skagit River from the upper end of Ross Lake to the Gorge Powerhouse tailrace. The Operations Model will include Ross Lake, Ross Dam and Powerhouse, Diablo Lake, Diablo Dam and Powerhouse, Gorge Lake, Gorge Dam, the Gorge Dam bypass reach, and the Gorge Powerhouse and tailrace.

5.3.1.4 Summary of Study Methods and Approach

City Light will develop, calibrate, and validate the Operations Model that integrates each of the three Skagit River Developments and supports the evaluation of proposed and potential recommendations for Project operations at an hourly (or higher resolution) time-step and under various reservoir inflow and outflow conditions. The Operations Model will be trained on historical inflow and operations data. It will be capable of predicting powerhouse and spillway flows, reservoir elevations, surface areas, available storage, and generation that would result from various operational scenarios considering a range of potential hydrometric inputs including alternative climate scenarios.

When the Operations Model is completed, an Operations Model Verification Report will be developed and presented to LPs. A base case scenario or scenarios will be developed which replicates the current operating requirements, agreements, and protocols for the Project. Scenarios developed by City Light or LPs will be compared to a base case scenario.

The proposed approach is to use a deterministic Operations Model to perform model runs, comparing outputs/effects relative to a base case scenario. The Operations Model will not contain random inputs or computations and will not optimize water distribution beyond City Light's current protocols and procedures. This alternatives analysis process will then show the direct effect of proposed operating protocols on Project operations and other endpoints of interest.

5.3.2 Reservoir Shoreline Erosion Assessment

5.3.2.1 Summary of Issue

Ongoing erosion at Project reservoirs (Ross, Diablo, and Gorge lakes) has the potential to affect terrestrial vegetation, RTE plant communities, cultural resources, and recreation resources along the shoreline. When reservoir water levels, particularly in Ross Lake, are below maximum water surface elevation, there is erosion within the drawdown zone, but minimal Project-related erosion at the maximum water surface elevation shoreline. An inventory of erosion areas was completed in the late 1980s for the current Project license, and erosion control measures and shoreline erosion monitoring at selected sites has taken place annually since 1995. This study will update the previous shoreline erosion inventory and will assess currently known areas of shoreline erosion and the effectiveness of erosion control measures at these sites; and identify any new erosion sites. Study results will provide information that will be used to evaluate the effects of shoreline erosion on resources of concern.

5.3.2.2 Goals and Objectives of Study

The goal of the Reservoir Shoreline Erosion Assessment is to provide information on the current status of eroding shoreline areas to determine potential impacts on resources of concern. The objectives are as follows:

- Update the 1990 reservoir erosion inventory to identify ongoing areas of reservoir erosion.
- Correlate existing erosion rate data collected at monitoring sites during the current Project license term with erosion site characteristics (e.g., underlying geology, slope, aspect, shoreline height, and landform) to estimate erosion rates at unmeasured sites.
- Assess the current condition and effectiveness of existing erosion control measures.

5.3.2.3 Geographic Scope

The study area will include shorelines of Ross (within waters of the United States), Diablo, and Gorge lakes.

5.3.2.4 Summary of Study Methods and Approach

Proposed Reservoir Shoreline Erosion Assessment tasks include:

- Compile relevant existing reservoir erosion data from NPS, LIDAR, landform mapping, geologic mapping, and aerial photographs for the reservoirs.

- Update landform and large, shoreline landslide mapping from current LIDAR as needed.
- Digitize erosion areas from the 1990 reservoir erosion inventory to create a GIS database so past sites can be accurately identified using GPS during the field inventory and compared to new sites.
- Conduct a field inventory of shoreline erosion along the three reservoirs by boat and foot under near normal maximum water surface elevation conditions. This will involve mapping erosion locations and collecting relevant characteristics such as eroding length and bank height (or area as appropriate), disturbed and undisturbed bank gradient, bank composition/geology, type of erosion, aspect, factors that appear to be affecting erosion, any evidence of seepage/groundwater, condition and type of any stabilization measures, potential resource effects, and any evidence of recent erosion.
- Conduct field inventory and assessment of existing erosion control measures including location, type, condition, and maintenance/repair needs (some of this information may already be available from NPS surveys).
- If resolution is sufficient, compare bank retreat rates using historical and current aerial photographs and/or LIDAR.
- Develop correlations between relevant site characteristics (e.g., geology, slope, aspect, groundwater) and erosion severity/rate to aid in erosion control planning.

5.3.3 Study of Erosion and Geologic Hazards at Project Facilities and Transmission Line Corridor

5.3.3.1 Summary of Issue

There are a variety of erosion and drainage concerns associated with ongoing Project O&M as well as naturally occurring geologic hazards; these can affect Project facilities, aquatic habitat, terrestrial and riparian habitat, cultural and recreation resources, and water quality. This study will identify and evaluate the interaction of Project facilities, including the transmission line corridor, and operations with erosion/drainage and geologic hazards as well as potential effects on other resources.

5.3.3.2 Goals and Objectives of Study

The goal of this study is to inventory the erosion and slope stability issues that may overlap with sensitive resources or Project facilities in Project Boundary. The objectives are as follows:

- Identify, map, and characterize areas of erosion, runoff, and mass wasting, as well as culvert conditions that are related to Project facilities, roads, townsites, and transmission towers that may be affecting other resources.
- Identify mass wasting (landslide, rockfall) and channel erosion hazards (e.g., channel migration, bank erosion) that could affect Project facilities, roads, or transmission towers.
- Identify maintenance activities along the transmission line corridor that are adjacent to stream crossings (e.g., road grading, ditch maintenance, vegetation management, streambank protection).

- Inventory rivers and streams crossing Project facilities and the transmission line corridor or within close proximity (including culverts and drainage ditches) to evaluate potential effects on aquatic, wetland, riparian, or water quality resources as well as potential risks to infrastructure and operations.

5.3.3.3 Geographic Scope

The Study of Erosion and Geologic Hazards at Project Facilities and Transmission Line Corridor will cover areas within the Project Boundary (including mitigation lands) from Ross Dam to the Bothell Substation including:

- Project dams, powerhouses, transmission lines, and other facilities
- Project townsites
- Project-related roads

Note that erosion of Project reservoir shorelines is included in the Reservoir Shoreline Erosion Assessment.

5.3.3.4 Summary of Study Methods and Approach

Proposed study methods include:

- Collect available information on geology, mass wasting hazards, culverts/fish passage, and streams (fish presence/absence) within the Project Boundary.
- Determine which roads/access corridors are Project-related.
- Map mass wasting and geologic hazards (including channel migration) within the Project Boundary using existing mapping, LIDAR, and aerial photographs.
- Summarize stream conditions, fish presence/absence, and culvert passage based on existing information within the Project Boundary.
- Prioritize areas for field inventory based on desktop analysis.
- Conduct a field inventory of prioritized Project-related roads (including transmission line and mitigation land roads), townsites, and facilities to collect missing information on erosion, mass wasting, drainage issues, and culvert condition (including assessment of fish passage at stream crossing culverts).
- Collect aquatic and riparian habitat and bank condition information at transmission line crossings of major streams that do not have adequate existing information (streams to be identified with the RWG).

5.3.4 Study of Sediment Deposition in Reservoirs Affecting Resources of Concern

5.3.4.1 Summary of Issue

Ongoing sediment deposition in tributary deltas resulting from operation of Project reservoirs is affecting some recreation resources (boat launches) and/or power generation. Deposition is an ongoing process and will continue over the term of the next license. Locations affected by sediment deposition include the following:

- Ross Lake: Deposition at the head of Ross Lake may be affecting the International Point boat launch at Hozomeen.
- Diablo Lake: Deposition in Thunder Arm is affecting the boat launch and ADA fishing dock at the Colonial Creek Campground.
- Diablo Lake: Deposition at Sourdough Creek is potentially affecting marine facilities.
- Gorge Lake: Deposition where Stetattle Creek enters Gorge Lake is reducing power generation by raising the Diablo Powerhouse tailwater elevation and affecting the Gorge Campground boat launch and shoreline vegetation across from the powerhouse.

5.3.4.2 Goals and Objectives of Study

The goal of the Reservoir Deposition Affecting Resource Areas of Concern study is to evaluate the effects of deposition on specific recreational resources and site operations within Ross, Diablo, and Gorge lakes. The study will collect information on the physical conditions under which deposition occurs in four locations. The objectives are as follows:

- Describe and map the location and history of sediment deposition in the Skagit River delta at the upper end of Ross Lake at Hozomeen; in the Sourdough Creek alluvial fan; at Thunder Arm in Diablo Lake; and at the Stetattle Creek confluence with Gorge Lake.
- Determine rate and grain size of sediment input, quantify volume of sediment deposition in deltas, and estimate rate and patterns of deposition.

5.3.4.3 Geographic Scope

This study will include the Skagit River delta (Ross Lake, Hozomeen and Winnebago Flats boat launches), Thunder Arm (Diablo Lake), Sourdough Creek (Diablo Lake), and Stetattle Creek delta (Gorge Lake).

5.3.4.4 Summary of Study Methods and Approach

Proposed study methods include:

- Collect bathymetry at the Hozomeen and Thunder Arm and other sites if needed to supplement current LIDAR data. Data are available for the Stetattle Creek delta.
- Collect grain size samples in the deltas at all four locations.
- Determine deposition rates and patterns.

5.3.5 Study of Geomorphology Between Gorge Dam and Sauk River

5.3.5.1 Summary of Issue

Project operations alter peak flows in the Skagit River downstream of Gorge Dam, thereby altering geomorphic processes that affect aquatic habitat. Geomorphic processes affect aquatic habitat by influencing substrate size and quality, large wood dynamics, main channel and side channel habitat diversity, and floodplain connectivity. Information on geomorphic processes and aquatic habitat downstream of Gorge Dam is needed to improve the understanding of the current spawning and rearing capacities of anadromous salmonids, the effects of geomorphic processes on other resources (e.g., cultural sites) and how Project operations may influence these factors over the next license term.

5.3.5.2 Goals and Objectives of Study

The goal of this study is to provide information on geomorphic processes that influence aquatic habitat in the Skagit River between the Gorge Dam and the Sauk River confluence. The objective of this study is to provide an assessment of river conditions downstream of Gorge Dam to evaluate Project-related changes to the following channel attributes:

- Channel configuration and geomorphic dynamics;
- Existing gravel quantities, locations, and grain size;
- Existing large wood input, transport, and retention;
- Side channels and off-channel habitat (existing channels; formation and maintenance processes); and
- Aquatic habitat types, characteristics, and availability.

5.3.5.3 Geographic Scope

This study area includes the collection of new information in the Skagit River and tributary deltas between Gorge Dam and the Sauk River confluence. This study will also compile existing relevant information from the Sauk River confluence downstream.

5.3.5.4 Summary of Study Methods and Approach

A comprehensive inventory of the existing aquatic habitat and geomorphic conditions will provide information needed to understand the potential limiting factors for anadromous fish that rely on habitats from Gorge Dam to the Sauk River confluence. Methods include collecting new information on aquatic habitat, substrate, channel configuration, geomorphic change, large wood, side channel and off-channel habitat from Gorge Dam to the Sauk River confluence and compiling existing relevant information downstream of the Sauk River confluence. Specific tasks are identified below.

- Map aquatic habitat using aerial photographs and LIDAR with field inventory; elements to be mapped include habitat type, substrate composition, tributary access, and side channel/off channel habitat.
- Map historical channel locations to estimate channel migration rates in the Skagit River between Gorge Dam and the Sauk River over the term of the last license to inform likely channel migration rates during a new license term.
- Evaluate current bank conditions and any evidence of channel incision.
- Collect surface and subsurface pebble counts on representative bars and in tributary deltas to characterize grain size.
- Conduct an analysis of flows needed to initiate gravel transport at key spawning locations and flows that may scour to redd depth.
- Inventory large wood in the Skagit River between Gorge Dam and the Sauk River, including

the mainstem, side channels, off-channel areas, and tributary mouths.

- Develop a sediment and large wood input budget for existing conditions in the Skagit River between Gorge Dam and the Sauk River.
- Integrate aquatic habitat, side channel, substrate, large wood, and fish use data to determine opportunities to improve aquatic habitat.
- Compile existing relevant geomorphology information downstream of the Sauk River confluence.

5.3.6 Water Quality Monitoring

5.3.6.1 Summary of Issue

Operations of hydroelectric facilities can affect water quality (e.g., temperature, dissolved oxygen, TDG), and water quality certification under Section 401 of the Clean Water Act applies to FERC relicensing. Ecology is responsible for issuing certifications in the State of Washington. City Light is committed to working with Ecology to ensure that information is available to support water quality certification.

5.3.6.2 Goals and Objectives of Study

The goal of this study is to monitor water quality parameters for which existing information is insufficient to characterize conditions within the Project Boundary. These include:

- Turbidity in Ross Lake
- Fecal coliform in Ross Lake
- Dissolved oxygen and pH profiles in Diablo Lake
- Dissolved oxygen and pH profiles in Gorge Lake
- Temperature and dissolved oxygen in the Gorge bypass reach
- TDG during spill events below Gorge Dam and Gorge Powerhouse
- Dissolved oxygen, pH, and turbidity below Gorge Powerhouse

5.3.6.3 Geographic Scope

The study will be conducted in Ross, Diablo, and Gorge lakes, the Gorge bypass reach, and in the Skagit River immediately below the Gorge Powerhouse.

5.3.6.4 Summary of Study Methods and Approach

Ross Lake

City Light proposes to collect data for one field season to establish background turbidity levels within Ross Lake. Sampling will be conducted continuously, using a Hydrolab® multiparameter sonde or equivalent, at three general locations in the reservoir: Pumpkin Mountain (48.7904, -121.0496), Skymo (48.8547, -121.0308), and Little Beaver (48.9274, -121.0625). Actual measurement locations will be determined in consultation with Ecology. Sampling will be conducted to characterize conditions during reservoir drawdown in fall, minimum pool elevation in winter, reservoir refill in spring, and full pool during summer.

There are few potential anthropogenic sources of fecal coliform in Ross Lake. City Light proposes to collect fecal coliform data during summer at the following locations, chosen because they experience relatively high levels of use (exact sampling locations will be identified in consultation with Ecology): Hozomeen, Ross Lake Resort, and at three boat access camps managed by the NPS (the camps to be sampled will be determined in consultation with Ecology and the NPS). Samples will be collected according to Ecology’s standard operating procedures and sent to an accredited laboratory for analysis.

Diablo Lake

Dissolved oxygen and pH profile measurements will be taken at the upper end of Diablo Lake and in the Diablo Lake forebay using a Hydrolab® multiparameter sonde with depth probe or equivalent equipment. Actual measurement locations will be identified in consultation with Ecology. Sampling will be conducted once per month from June through September to document conditions during the warmest time of year, i.e., when dissolved oxygen concentrations can be at their lowest.

Gorge Lake

Dissolved oxygen and pH profile measurements will be taken at the upper end of Gorge Lake and in the Gorge Lake forebay using a Hydrolab® multiparameter sonde with depth probe or equivalent equipment. Actual measurement locations will be identified in consultation with Ecology. Sampling will be conducted once per month from June through September to document conditions during the warmest time of year.

Gorge Bypass Reach

Temperature and dissolved oxygen will be measured at two locations in the Gorge bypass reach using a Hydrolab® multiparameter sonde or equivalent equipment: near Gorge Dam and in the reach downstream of the fish barrier located 0.6 miles upstream of the Gorge Powerhouse. Actual measurement locations will be identified in consultation with Ecology. Sampling will be conducted once per month from June through September to document conditions during the warmest time of year.

Gorge Dam and Gorge Powerhouse

City Light proposes to measure TDG during Gorge Dam spill events at two monitoring locations, below Gorge Dam and below Gorge Powerhouse, using a Hydrolab® TDG sensor (or equivalent). Actual measurement locations will be determined in consultation with Ecology. Sensors will be deployed continuously for one year to characterize TDG over a range of spill conditions.

Dissolved oxygen, pH, and turbidity will be measured continuously for approximately one year in the Gorge Powerhouse tailrace using a Hydrolab® multiparameter sonde or equivalent.

5.3.7 Instream Flow Model

5.3.7.1 Summary of Issue

Project operations influence flows in the Skagit River downstream of Gorge Powerhouse which in turn influences the availability and suitability of aquatic habitat. During relicensing, City Light plans to develop tools to evaluate operational scenarios that optimize environmental protection and generation needs. Development of and/or updates to hydraulic modeling tools will be necessary to support comprehensive evaluations of operational scenarios during the next license term. In tandem with the Operations Model, the hydraulic model will support evaluations of whether alternative operational scenarios can achieve environmental protections (e.g., flows for habitat protection or formation, geomorphic process flows, recreation) while also meeting Project operational requirements and minimizing constraints.

5.3.7.2 Goals and Objectives of Study

The goal of the Instream Flow Model Study is to provide a tool to evaluate flows and aquatic flow/habitat in the Skagit River between the Gorge Powerhouse and the confluence with the Sauk River. The objectives are as follows:

- Develop, calibrate, and validate a numerical hydraulic model of the Skagit River for the reach between the Gorge Powerhouse and the confluence with the Sauk River.
- Integrate hydraulic model outputs with biological (species, lifestages, periodicities, etc.) and physical (depth, velocity) criteria used in the current flow/habitat management tool to develop flow/habitat relationships.

Once the study is complete (i.e., the model has been developed), the flow/habitat model will be used to investigate and inform the evaluation of flows and habitat in the reach to continue supporting mainstem Skagit River fish production during the next license term.

5.3.7.3 Geographic Scope

The geographic scope to be addressed by the hydraulic model includes the Skagit River downstream of Gorge Powerhouse to the confluence of the Sauk River.

5.3.7.4 Summary of Approach

A three-dimensional surface will be built to develop a hydraulic model of the Skagit River from Gorge Powerhouse to the Sauk River confluence.

5.3.8 Reservoir Fish Stranding and Trapping Risk Assessment

5.3.8.1 Summary of Issue

Native fish may be stranded or trapped in Ross, Diablo, or Gorge lakes during reservoir drawdowns and/or surface elevation fluctuations.

Although stranding and trapping are related processes, there are differences that require separate analyses. Stranding involves the beaching of fish as water levels recede and is typically associated with low gradient shoreline areas or cover that result in fish remaining in an area as it is dewatered.

Mortality occurs when stranded fish are beached on the dewatered shoreline. Trapping is the retention of fish, as water levels recede, in pools formed by topographic depressions. Stress and potential mortality can occur to trapped fish due to water temperature fluctuations and reduced dissolved oxygen, predation, and stranding as the water in the pool infiltrates into the substrate.

5.3.8.2 Goals and Objectives of Study

The goal of the Reservoir Fish Stranding and Trapping Risk Assessment is to assess native fish trapping and stranding risk within the three reservoirs due to Project operations. Native fish species are defined as resident Rainbow Trout, Bull Trout, and Dolly Varden. The objectives are as follows:

- Identify and quantify the areas where stranding and trapping could occur in Ross, Diablo, and Gorge lakes under current operations.
- Determine the frequency and the time periods when stranding and trapping may occur in the reservoirs.

5.3.8.3 Geographic Scope

The study area includes Ross, Diablo, and Gorge lakes.

5.3.8.4 Summary of Study Methods and Approach

Areas of stranding and trapping risk in Project reservoirs will be identified using a two-step process:

- Conduct a desktop analysis:
  - Use existing LIDAR and reservoir bathymetry to identify areas where stranding or trapping could occur. Habitats to be identified are areas with depressions, low gradient bars, and side channels.
  - Using existing native salmonid life-stage periodicities, identify time periods during which native salmonids subject to stranding and trapping (e.g., fry) may be present in Project reservoirs.
  - Overlay reservoir drawdown/fluctuation information resulting from current Project operations on the preliminary map of stranding and trapping areas.
- Field validation
  - Field validate, opportunistically, at areas of risk for stranding or trapping. Based on the numbers and types of trapping and stranding habitats identified, subsampling may be considered.
  - Use data from field validation to modify results of the desktop analysis. The GIS analysis will provide a quantification of areas where stranding and trapping is likely to occur at specific drawdown rates and within specific reservoir elevation ranges.

5.3.9 Vegetation Mapping Study

5.3.9.1 Summary of Issue

The Vegetation Mapping Study will be used to establish a baseline characterization of vegetation resources within the Project Boundary and a 0.5-mile buffer around the Project Boundary. This study is scheduled for 2020 and the draft study plan is appended to this PAD.

5.3.9.2 Goals and Objectives of Study

The goal of the Vegetation Mapping Study is to develop a complete and systematic vegetation mapping GIS database to describe existing conditions. The objectives are as follows:

- Compile existing data and use remote sensing to describe and map vegetation to the "Group" level within the study area (see Geographic Scope, below) using the USNVC.[42]
- Develop an overlay of potential Project-related disturbances to prioritize field surveys.
- Describe baseline vegetation resources and environmental conditions within the study area.
- Provide information on wetland communities within the study area (see Wetland Assessment).
- Provide information for assessing wildlife habitat (e.g., marbled murrelet, golden eagle, northern goshawk, beaver) within the study area.

5.3.9.3 Geographic Scope

This study area will include land within the Project Boundary and fish and wildlife mitigation lands, and a 0.5-mile buffer around the study area. It will also include the channel migration zone from Gorge Powerhouse to the confluence of the Sauk and Skagit rivers.

5.3.9.4 Summary of Study Methods and Approach

The study will consist of the following proposed tasks:

- Compile and summarize existing information derived from reports and databases.
- Validate the NPS vegetation mapping inventory for the North Cascades National Park using the completed NPS field and map products as a basis for analysis. The NPS field and remote sensing (random forest modeling [Breiman 2001] and Object-based Image Analysis [OBIA]) framework will be applied to complete vegetation mapping in the study area outside of the North Cascades National Park.
- Pre-process Geospatial Resources (Imagery, LIDAR) for incorporation into the analysis. Pre-processing will include re-projecting datasets into a common geographic projection and clipping data to the study extent.
- Integrate NPS vegetation mapping and classification output into the final maps. To align results with the NPS classification, NPS results will be clipped to the study extent, and the NPS classification results mapped at the Group level (i.e., combinations of relatively narrow sets of plant species, including dominants and co-dominants, broadly similar composition, and

[42] For more information on the NVC Standard and categories including definitions for Group, Association, and Alliance levels, see: http://usnvc.org/data-standard/natural-vegetation-classification/.

diagnostics growth forms) will be spot-checked based on limited field verifications, with a focus on areas with the greatest potential for Project effects.

- Create a Group-level vegetation map based on a random forest model using multiple sources of remotely sensed and ancillary input variables. A preliminary classification map will be produced for the area not mapped by the NPS to interpret the initial model results; identify areas to review in the field to inform the model; and assist with field data collection. The classification will be refined, and its accuracy validated using field data.
- Develop a preliminary random forest model using NPS data. Training data will be maximized by identifying as many of the NPS data plots within the study area as possible. Preliminary modeling results will provide for an early assessment of the random forest model and can be used to stratify sampling for field data collection. The accuracy of the preliminary classification will be assessed using field data points collected by the NPS in the North Cascades National Park.
- Conduct fieldwork at representative sites using a stratified sampling approach to build an initial training and validation dataset to verify areas within the potential effects overlay and where model interpretation is less certain. Field data collection will be limited to sites that are safely accessible. The training dataset will be supplemented with opportunistic sampling conducted during travel to designated sample points. Validation data points will not include opportunistic data collection.
- Develop draft and final vegetation maps. Final maps will be based on the more computationally intensive OBIA approach instead of the pixel-based approach used in the preliminary modeling. Vegetation patches less than five square meters will be removed to prevent the "popcorn" effect that can make maps illegible. In addition, manual refinements will be applied using very high spatial resolution imagery to address clear visual errors.
- Assess the accuracy of the final habitat classification using standard accuracy assessment procedures as outlined in Congalton and Green (2010). The goal will be to achieve 80 percent overall accuracy (i.e., consistent with NPS vegetation mapping inventory approach).

5.3.10 Wetland Assessment

5.3.10.1 Summary of Issue

A wetlands functional analysis is needed to assess potential Project effects and enable relevant agencies to meet their regulatory mandates within the FERC relicensing process. The Wetland Assessment will establish a baseline characterization of wetland resources within the Project Boundary and the channel migration zone from Gorge Powerhouse to the confluence of the Sauk and Skagit rivers. This study is planned for 2020 and a draft study plan is appended to this PAD.

5.3.10.2 Goals and Objectives of Study

The goal of the wetland assessment is to assess the condition and function of the wetlands in the study area and determine Project effects. The objectives are as follows:

- Assess functions and values of wetlands in the study area.
- Identify wetlands potentially impacted by Project O&M or Project-related recreation.

- Document the characteristics of wetlands potentially affected by the Project, including possible sources of any observed impairments.

5.3.10.3 Geographic Scope

This study will include land within the Project Boundary and the channel migration zone from Gorge Powerhouse to the confluence of the Sauk and Skagit rivers. Field sampling will emphasize wetlands potentially affected by Project O&M or Project-related recreation; wetlands farther from potential impact sources will undergo desktop analysis.

5.3.10.4 Summary of Study Methods and Approach

The study will consist of the following tasks:

- Refine existing maps derived from remote sensing and map wetlands in a uniform manner based on the USFWS's Classification of Wetlands and Deepwater Habitat of the United States (Cowardin et al. 1979) classification system.
- Conduct a limited field reconnaissance to verify existing wetland data, including an assessment of the accuracy of mapped data and wetland classifications; the reconnaissance will also provide information on plant occurrence and density, which will be used, as needed, to adjust the existing wetland map that will be used by the remote sensing wetland model.
- Use the Washington DNR's Wetland Intrinsic Potential (WIP) tool to identify wetlands not included in existing mapping inventories; the WIP tool was designed to identify wetlands that cannot be detected in aerial imagery because they are ephemeral or obscured by the tree canopy.
- Use the Washington State Wetland Rating System for Western Washington (Hruby 2014) to assess wetland functions and values.
- Develop a disturbance potential overlay to identify areas potentially affected by Project O&M or Project-related recreation.
- Conduct fieldwork within the disturbance overlay areas, including plant species documentation; indicators of hydric vegetation, hydric soils, and wetland hydrology per the Regional Supplement to the USACE Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (USACE 2010). Jurisdictional wetland delineations will not be completed, and official wetland data plots will not be established. Wetlands with the potential to be directly affected by the Project will undergo a functional analysis using Hruby (2014). Additional documentation will include sources of wetland hydrology, observed impairments, and habitat information relevant to other studies.

5.3.11 RTE Plant Study

5.3.11.1 Summary of Issue

Information on RTE plants is needed to identify existing species and populations in areas potentially affected by ongoing Project activities, and inform development of BMPs, if needed, to protect these species during the new license term. It is currently unknown whether any RTE plant species occur in the directly affected areas.

5.3.11.2 Goals and Objectives of Study

The goal of the study is to describe RTE plant populations in areas affected by Project O&M and Project-related recreation. The objectives are as follows:

- Identify high probability habitat for RTE species where there is also the potential for Project effects.
- Determine the extent and characteristics of RTE plant species in areas potentially affected by Project O&M or related activities.
- Assess the threats to the continued occurrence of RTE plant species in areas directly affected by Project-related activities.

5.3.11.3 Geographic Scope

Mapping of potential habitat for target RTE plant species will cover the lands within the Project Boundary and fish and wildlife mitigation lands. Field sampling will be focused on sites with potential RTE habitat that could be affected by Project O&M and Project-related recreation.

5.3.11.4 Summary of Study Methods and Approach

The methods to be used are those commonly applied to identify RTE plant populations. A target list of RTE plant species with the potential to occur in the areas selected for survey will be developed using the WNHP Species of Special Concern list and lists of USFS Sensitive Species. The survey will require the use of RTE plant species location data from NPS and USFS.

For each species, the target list will include scientific and common names; USFWS, USFS, and WNHP status; primary identification periods; and habitat requirements. Data derived from the Vegetation Mapping Study and Wetland Assessment will be used, along with species habitat association information from the literature and University of Washington Herbarium, to map areas with high potential for the presence of RTE plant species. The maps will be overlaid in GIS with polygons showing areas potentially affected by Project operations or Project-related activities to narrow the area for field survey.

The potential survey sites will be evaluated to determine if they can be safely accessed. Qualified botanists will survey these selected areas using standard “intuitive controlled methods” (Nelson 1985), with special considerations for species identification. Survey times will be determined based on the flowering periods for specific plants. Herbarium specimens will be reviewed as necessary prior to field survey. All RTE plant populations found will be recorded with GPS points along with all other relevant information that is typical of an RTE plant survey.

5.3.12 Invasive Plants Inventory

5.3.12.1 Summary of Issue

Invasive species infestations have the potential to adversely affect the quality of native plant, fish, and wildlife habitat within and near the Project Boundary. The State of Washington, and Whatcom, Skagit and Snohomish counties have regulatory requirements for landowners to control select invasive plant species on their property. In addition, NPS and USFS have policies regarding the control of invasive species on federally-administered lands. Project O&M activities and recreation that bring in material or equipment from outside the Project Boundary, or that cause ground disturbance, can contribute to the introduction and spread of invasive plants. An inventory of non-native, invasive plant species is necessary for understanding risks and management options to reduce adverse ecological effects of non-native plants and to reduce the potential for weed species to spread to adjacent properties.

5.3.12.2 Goals and Objectives of Study

The goal of the study is to understand where and how Project operations or Project-related recreation may influence the occurrence and spread of non-native species. The objectives are as follows:

- Identify invasive species occurring in the study area and assess the risk these species present to native fish and wildlife habitat.
- Determine the location and extent of invasive species infestations in the Project Boundary.
- Identify the vectors for weed dispersal within the Project Boundary and where these occur.
- Provide the information needed for a long-term weed management plan.

5.3.12.3 Geographic Scope

This study will be conducted on lands within the Project Boundary, with emphasis on locations where there are Project-related vectors and susceptibility to infestation. This will include along the reservoir fluctuation zone, recreation sites, and in sections of the transmission line where there is high risk of weed infestation. The inventory will also include the riverbanks between Gorge Dam and the Sauk River confluence and select sites on fish and wildlife mitigation lands where there are vectors for the spread of invasive species.

5.3.12.4 Summary of Study Methods and Approach

- Compile a target list of invasive species that either require control based on State or county regulation, are prioritized for control by the USFS or NPS, or that have the potential to cause ecological harm within the Project Boundary or on adjacent lands.
- Refine study area based on locations of weed vectors and potentially affected areas within the Project Boundary.
- Identify survey sites and protocols for sampling in areas where existing information is inadequate.
- Conduct a field survey to map invasive species infestations via GPS and collect data on species composition, plant density, and weed vectors.

5.3.13 Marbled Murrelet Study

5.3.13.1 Summary of Issue

The federally-listed marbled murrelet was observed by NPS staff on Ross Lake in 2017 (Ransom 2019) and there have been other possible detections of this species in or near the Project Boundary. However, no surveys or habitat assessments have been conducted within the Project Boundary.

The USFWS has indicated the need for data on murrelet occurrence to fulfill its requirements under the ESA in the context of Project relicensing.

5.3.13.2 Goals and Objectives of Study

The goals of this study are to determine if potential marbled murrelet nesting habitat occurs within the Project Boundary and if this habitat is used/occupied. The objectives are as follows:

- Develop a map of suitable murrelet nesting habitat within the study area.
- Document murrelet flight activity at selected sites along the upper portions of the transmission line corridor and Project reservoirs.
- If present, evaluate the need for and feasibility of using auditory/visual surveys to identify forest stands potentially being used by nesting murrelets.

5.3.13.3 Geographic Scope

This study area will include land within the Project Boundary and fish and wildlife mitigation lands, with emphasis on locations where suitable marbled murrelet nesting habitat and potential Project effects may intersect.

5.3.13.4 Summary of Study Methods and Approach

The study will adhere to currently accepted scientific methods for evaluating marbled murrelet habitat suitability, assessing potential for noise disturbance, developing a sampling protocol, analyzing potential Project effects, and developing appropriate potential PME measures. The general steps for conducting the study include:

- Compile existing data on the occurrence of murrelets within or near the study area.
- Review scientific literature and agency guidelines to obtain criteria for marbled murrelet nesting habitat.
- Assemble NPS vegetation map and other related data and identify areas of suitable murrelet habitat within the study area.
- Develop an overlay of potential noise disturbance from information generated by the Project Operation Sound Assessment.
- Develop a radar sampling plan based on the above information to effectively collect data at selected sites. Locations of radar sampling stations will be determined based on the occurrence of suitable habitat, intersection with potential Project effect vectors, sampling efficiency, and logistics.
- Conduct one season of radar surveys for marbled murrelets at selected sites.
- Review results and determine if field reconnaissance of habitat or follow-up acoustic/visual survey is warranted.

5.3.14 Golden Eagle Habitat Analysis Study

5.3.14.1 Summary of Issue

The NPS and the WDFW have limited data on golden eagle nests within several miles of the Project and NPS biologists have observed occasional individual birds in the Skagit Valley in winter and spring as recently as 2019. However, habitat assessments or migratory studies specific to golden eagles have not occurred within the Project Boundary. WDFW has raised concern about the potential threat to the species from collisions with powerlines, although there is currently no evidence of a collision threat for golden eagles at the Project.

5.3.14.2 Goals and Objectives of Study

The goal of this study is to determine if there is potential golden eagle nesting and foraging habitat or migratory routes within the Project transmission line corridor. The objectives are as follows:

- Determine the potential use of transmission line corridors for foraging by golden eagles and the potential threat of collisions with transmission lines.
- Summarize existing information on golden eagle occurrence within the Project Boundary and vicinity.
- Develop a map of suitable nesting habitat, foraging habitat, and migratory routes that intersect with the transmission line corridor within the Project Boundary.

5.3.14.3 Geographic Scope

This study will include land within the Project Boundary, with an emphasis on locations where suitable habitat and potential Project-related effects intersect along the transmission line corridor.

5.3.14.4 Summary of Study Methods and Approach

The study will adhere to currently accepted scientific methods for evaluating golden eagle habitat suitability, likely migration routes, developing a limited sampling protocol, and analyzing potential Project-related effects. The general steps for conducting the study include:

- Conduct a literature review for information on the use of transmission line corridors for foraging by golden eagles and the potential for collision.
- Compile existing data on the occurrence of golden eagles within the study area.
- Review scientific literature and agency guidelines to assess criteria for golden eagle nesting and migratory habitats.
- Use results of vegetation mapping study and other related data such as NPS and USFS mapping to determine areas of suitable golden eagle habitat within and near the Project Boundary.
- Use Project transmission line characteristics to assess the risk of collision.

5.3.15 Northern Goshawk Habitat Analysis Study

5.3.15.1 Summary of Issue

The northern goshawk is listed as a priority species by WDFW and is a Candidate species for state listing. Several recent goshawk sightings within the Project Boundary and general Project vicinity are noted on eBird (eBird 2019), but relatively little is known if northern goshawk habitat exists in or near the Project Boundary. WDFW specifically requested this habitat analysis.

5.3.15.2 Goals and Objectives of Study

The goal of this study is to identify suitable goshawk habitat within the Project Boundary to assess the potential for goshawk occurrence. WDFW has specifically requested this habitat analysis, and City Light has agreed to do so as it has a mutual natural resource management interest. The objectives are as follows:

- Conduct a literature review of the potential use of the Project Boundary for nesting by northern goshawks.
- Develop a map of suitable habitat within the Project Boundary based on existing vegetation mapping, LIDAR, and criteria identified in the scientific literature.

5.3.15.3 Geographic Scope

This study will include land within the Project Boundary and a zone within 0.5 mile of the Project Boundary, with an emphasis on locations where suitable habitat and potential Project effects may intersect. The study area does not include wildlife mitigation lands as there are no potential Project-related disturbance sources on these parcels.

5.3.15.4 Summary of Study Methods and Approach

The study will adhere to currently accepted scientific methods for evaluating northern goshawk habitat suitability, potential for noise disturbance, and to provide information to analyze potential Project effects. The general steps for conducting the study include:

- Compile existing data on the occurrence of northern goshawk within or near the Project Boundary.
- Review scientific literature and agency guidelines to assess criteria for northern goshawk nesting habitat.
- Assemble vegetation map, LIDAR, and other related data, and determine areas of suitable northern goshawk nesting habitat within the study area.
- Create an overlay of areas where Project-related activities intersect with suitable goshawk nesting habitat.

5.3.16 Special-Status Amphibian Study

5.3.16.1 Summary of Issue

Few amphibian studies have been conducted in wetland habitat along the Project reservoirs so species occurrence information within the Project Boundary is inadequate to assess potential effects of Project operations and Project-related recreation on spotted frog or its habitat. If this species breeds in wetlands along the reservoirs, Project effects from operations or Project-related recreation are possible.

Because of the federal listing status of Oregon spotted frog, study results will also be used to inform USFWS Section 7 ESA consultation on the Project. While assessing spotting frogs, data on breeding use by all other amphibian species will also be collected to assess how wetlands and reservoir drawdown zones are used.

5.3.16.2 Goals and Objectives of Study

The goal of this study is to identify areas within the Project Boundary where potential suitable Oregon and Columbia spotted frog breeding habitat occurs and determine species presence. The objectives are as follows:

- Identify potential suitable Oregon and Columbia spotted frog breeding habitat within the Project Boundary.
- Assess breeding use of habitats associated with the Project reservoirs by spotted frogs and other pond-breeding amphibian species.

5.3.16.3 Geographic Scope

This study will focus on wetlands and littoral zones along the three Project reservoirs within the Project Boundary.

5.3.16.4 Summary of Study Methods and Approach

The study will adhere to currently accepted scientific methods for evaluating habitat suitability for Columbia spotted frog and Oregon spotted frog to develop a limited sampling protocol. The general steps for conducting the study include:

- Use the vegetation map, wetland characterization information and other related data to identify areas of suitable spotted frog habitat within the Project Boundary.
- Review results and determine where field reconnaissance of amphibian habitat is warranted during the Wetland Assessment.
- Develop and implement a sampling protocol involving visual surveys and, if feasible, genetic sampling (eDNA from waterbodies and/or collection of DNA via swabbing individuals and/or egg masses) to determine if Columbia or Oregon spotted frogs are present at sampling sites.
- Record the presence of other amphibian species at all sampling locations.

5.3.17 Beaver Habitat Assessment

5.3.17.1 Summary of Issue

The ability of the off-channel habitats created under the current Skagit license to support Chum Salmon spawning is routinely compromised by beaver dam construction. In recent years, beavers have been trapped to retain the function of the spawning channels. A statute was recently passed in Washington State that allows for the transfer of problem beavers from one area in a watershed to another in western Washington. City Light and LPs have a joint interest in reviewing the potential to transfer problem beavers to suitable habitat elsewhere in the watershed.

5.3.17.2 Goals and Objectives of Study

The goal of this study is to understand the magnitude and extent of ongoing beaver use of Chum Salmon spawning channels and to inform potential beaver relocations in the event that beaver relocation is deemed appropriate and feasible. The objectives are as follows:

- Identify beaver occurrence and potential habitat along the Project reservoirs and stream segments addressed by relicensing fisheries studies.
- Determine the suitability of potential beaver habitat in the study area.

5.3.17.3 Geographic Scope

The beaver conflict will be assessed in the general vicinity of the Chum Salmon spawning channels funded by City Light. Suitable beaver habitat will be identified within the geographic scope of the Vegetation Mapping Study as well as tributaries to the Skagit River upstream of the confluence with the Sauk River.

5.3.17.4 Summary of Study Methods and Approach

The following steps outline the methods that will be used to meet the goals and objectives of the assessment:

- Review NPS and other agency data on beaver occurrence within or near the Project Boundary.
- Review existing mapping of intrinsic beaver habitat along streams within the study area (draft provided to City Light by B. Dittbrenner on September 23, 2019 and WDFW version expected to be available in 2020). This mapping uses methods described by Dittbrenner et al. [2018]).
- Develop a GIS model of suitable potential beaver habitat in stream segments within the within the study area based on intrinsic morphological habitat (e.g. Dittbrenner et al. 2018) and ownership/use characteristics.
- Use the results of the Vegetation Mapping Study and the Wetland Assessment, along with the intrinsic habitat mapping and observations of beaver sign made during terrestrial and fisheries field investigations, to characterize beaver habitat suitability and occupancy within the study area.

5.3.18 Recreation Use and Facility Assessment

5.3.18.1 Summary of Issue

FERC regulations require that a license application include a description of existing recreation measures or facilities to be continued and maintained during the term of the new license; new measures or facilities proposed by the applicant for the purpose of enhancing recreational opportunities at the Project; and measures to ensure the safety of the public in its use of Project lands and waters. Recreation is a recognized Project purpose at FERC-licensed projects under Section 10(a) of the FPA.

5.3.18.2 Goals and Objectives of Study

The goals of this study are to determine: (1) the preferences, attitudes, and characteristics of the Project's recreation users; (2) the condition, accessibility, and use effects of Project recreation facilities; (3) current Project recreational use and activities and (4) future demand for Project recreation facilities and opportunities.

Goal 1 Objectives (Determine the Preferences, Attitudes, and Characteristics of the Project's Recreation Users)

- Describe recreation visitors and their trip characteristics, including seasonality, and access routes by Project recreation site.
- Describe user preferences and expectations of facilities at Project recreation sites.
- Identify recreation issues such as safety, conflicts, and crowding.
- Describe recreation visitors' activities (i.e., including primary activity and all activities engaged in while visiting) at Project recreation sites.
- Describe Project recreation visitors' socio-demographic characteristics.
- Describe Project recreation visitors' access experience and potential barriers to participation in recreation activities.

Goal 2 Objectives (Condition of Project Facilities, Impacts, and Accessibility)

- Evaluate accessibility at all existing Project recreation facilities.
- Inventory Project recreation facilities and trails and qualitatively document use impacts (e.g., erosion, user-created trails).
- Evaluate Project boat ramp usability.

Goals 3 and 4 Objectives (Current Project Recreational Activities and Future Demand for Activities)

- Identify the amount, activity type, and spatial and temporal distribution of existing and desired recreation use within the Project Boundary, and, where reasonable, describe historical recreation use trends within these areas.
- Identify Project-related recreation opportunities in the Project vicinity that may have unmet demand.
- Identify potential constraints or barriers to recreation use, particularly those potentially related to existing Project O&M.
- Roughly estimate future demand within the Project through the term of the new license (30 to 50 years).
- Assess the regional uniqueness and relative significance of the Project's primary recreation opportunities.

5.3.18.3 Geographic Scope

The geographic scope for this study area includes Project recreation sites within the Project Boundary.

5.3.18.4 Summary of Study Methods and Approach

Recreation uses and visitor attitudes, beliefs, and preferences at Project recreation sites will be documented using on-site visitor use surveys. The sampling frequency will be divided into two categories – peak and off-peak seasons. On-site visitor use surveys will include questions to help estimate the level of recreational fishing and fish catch.

The inventory of existing Project recreation facilities will include an assessment of the number, type, and condition of facilities. Accessibility of facilities and usable periods of the Project's public boat ramps will be recorded. Current recreation use and capacity at Project recreation sites will be recorded.

The study will assess future demand and regional recreation uses by considering available information on visitor use and facilities from non-Project regional managing entities (e.g., NPS, USFS, NCI, and Ross Lake Resort). Regional trends and projections in population growth and recreation use will be documented using available resources.

5.3.19 Gorge Bypass Reach Safety and Whitewater Boating Assessment

5.3.19.1 Summary of Issue

Water from Gorge Lake is conveyed via an intake structure at Gorge Dam into a tunnel to Gorge Powerhouse creating a bypass reach. LPs have expressed an interest in exploring the potential for whitewater paddling in the bypass reach.

5.3.19.2 Goals and Objectives of Study

The goal of this study is to evaluate the recreational whitewater boating potential under current conditions of the Gorge bypass reach and to evaluate the feasibility of expanding opportunities in this reach. The study has the following objectives:

- Describe the whitewater boating opportunity in the Gorge bypass reach including the whitewater difficulty, character of rapids, number of portages, and suitability for public use.
- Determine the range of flows that would provide whitewater boating opportunities in the Gorge bypass reach.
- Assess the operational safety, feasibility, and effects on generation of providing whitewater boating in the bypass reach.

5.3.19.3 Geographic Scope

The study area is the Gorge bypass reach. The reach consists largely of a deep, narrow canyon, and the river channel is relatively steep and complex.

5.3.19.4 Summary of Study Methods and Approach

The proposed methodology follows the approach described in Flows and Recreation: A Guide to Studies for River Professionals (Whittaker et al. 2005). It consists of a progressive approach with phased efforts of increasing resolution, as warranted by results of the previous analysis. Advancing to more intensive study levels is dependent on results and recommendations in Levels 1 and 2 respectively.

- Level 1: Desktop Analysis – Investigation will include literature reviews, structured interviews, summary of hydrology in the bypass reach, Gorge Dam spill gate operation, physical description of the river channel in the bypass, description of river access, and summary of regulatory agency resource management goals and tribal interests in the bypass reach. The Level 1 interim report will include explicit decision criteria determining whether to proceed to Level 2.
- Level 2: Field Reconnaissance – Investigation will involve opportunistic shore-based observation of flow in the bypass reach during a spill event. Progression to a Level 3 evaluation will be based on results from the Level 2 interim report.
- Level 3: Flow Evaluation – Opportunistic flow evaluation will consist of a team of six or fewer boaters paddling two to four flows based on volumes identified in the Level 2 Reconnaissance.

5.3.20 Project Facility Lighting Inventory

5.3.20.1 Summary of Issue

The Project has been identified by the NPS to be a source of light pollution in North Cascades National Park and RLNRA. The NPS made this determination using ground-based photometric measurements conducted at one site in 2012 (Hoffman et al. 2015). Light sources are currently being used at hydroelectric facilities, housing and security structures, and City Light visitor service facilities. Hoffman et al. (2015) identified Diablo Dam as one source of light pollution, with no shielding or other modifications to direct the light to where it is needed and reduce light disbursement and glare. Evaluation of City Light facilities and infrastructure within RLNRA will contribute to improved understanding of light sources and potentially to the development of measures to mitigate the effects of light pollution from the Project.

5.3.20.2 Goals and Objectives of Study

The goal of this study is to inventory existing lighting sources. The objectives are as follows:

- Identify Project facilities within RLNRA that utilize outdoor lighting.
- Describe lighting needs at each Project facility and the operating periodicity, design, intensity, and color of lights being used.

5.3.20.3 Geographic Scope

The study area includes all Project facilities within RLNRA that utilize lighting at night.

5.3.20.4 Summary of Study Methods and Approach

Proposed study tasks include:

- Collect and review existing data on nighttime lighting sources developed by the NPS and other relevant resource agencies.
- Inventory and map existing Project facilities and infrastructure within RLNRA that utilize lighting visible to the public at night.
- Identify the need/purpose for lighting at each Project facility.
- Describe the operating periodicity, design, intensity, and color of lights being used at each facility and note the existence of any shielding.

5.3.21 Project Operation Sound Assessment

5.3.21.1 Summary of Issue

City Light's Project facilities and O&M activities have the potential to generate noise, potentially affecting wildlife, cultural resources, and visitors to RLNRA. The NPS has conducted acoustic monitoring in RLNRA, which included monitoring of some Project facilities (NPS 2017). The NPS has requested additional sound data to inform the analysis of potential effects of Project related noise on resources.

5.3.21.2 Goals and Objectives of Study

The goal of this study is to determine if noise from Project facilities, equipment, or activities has the potential to affect resources in RLNRA. The objectives are as follows:

- Identify and describe Project facilities and equipment that emit sound.
- Quantify and model sound emanating from Project facilities and equipment.

5.3.21.3 Geographic Scope

The study area includes the Project powerhouses, dams, reservoirs, and associated facilities and equipment, and areas around these features, the extent of which will be established during early phases of the study.

5.3.21.4 Summary of Study Methods and Approach

The study would include the following steps:

- Inventory existing Project facilities and equipment and define location(s) and frequency/timing of use.
- Identify known sound pressure levels (SPL) for equipment based on manufacturers' specifications or other established data.
- Measure noise for sources without established SPL data.
- Establish acoustic monitoring stations within the study area; stations would be within the audible range of identified Project-related facilities and equipment.
- Conduct monitoring at acoustic monitoring stations.
- Calculate existing ambient sound based on monitoring data.

- Model Project-related sound (continuous and intermittent) using collected ambient sound data and considering terrain, surfaces, and possibly atmospheric factors.

5.3.22 Cultural Resources Data Synthesis Study

5.3.22.1 Summary of Issue

Section 106 of the NHPA requires federal agencies to consider the effects of their undertakings on historic properties and includes procedures for the "identification…and evaluation of historic properties" (36 CFR § 800.4). Project operations may be affecting, or may affect in the future, cultural resources that are eligible for listing in the NRHP. This synthesis will identify how new information will affect planning and implementation during the next license term. A draft of the study plan is appended to this PAD.

5.3.22.2 Goals and Objectives of Study

The goal of this study is to develop an understanding of the affected environment/current conditions for cultural resources within the study area. The objectives are as follows:

- Establish baseline conditions for cultural resources.
- Identify data gaps and the need for future study, consultation, or management plans.

Some of this information is expected to be confidential and will have restricted distribution.

5.3.22.3 Geographic Scope

This study will review information associated with the Project Boundary and associated lands. The literature review will include information available within a one-mile buffer surrounding the Project Boundary and fish and wildlife mitigation lands.

5.3.22.4 Summary of Study Methods and Approach

Study methods include literature and archival review, coordination with City Light and NPS personnel, and outreach with Indian tribes and First Nations to identify existing data.

- Collate and synthesize existing archaeological, historical, and ethnographic data within the study area.
- Summarize work done to date under the Skagit ARMMP and HRMMP related to capital improvement projects and monitoring in areas of cultural sensitivity.
- Provide documentation of Indian Tribe and First Nation affiliations and associations to the study area.
- Share the dataset with the CRWG to collectively build upon baseline.
- Analyze the dataset to identify data gaps and to determine necessary steps to resolve those gaps (e.g., updates, new studies, reports in preparation, and consultation).
- Produce a technical report that describes a baseline condition of cultural resources, which includes archaeological and historic resources, and properties of religious and cultural significance (e.g., TCP and TCL).

The CRWG will identify which information or studies are confidential, and distribution will be limited based on LPs' designations as to who from their agencies should have access to confidential material. Separate reporting will be necessary for historic built-environment resources and archaeological and tribal resources, which will be confidential.

5.3.23 Cultural Resources Survey

5.3.23.1 Summary of Issue

With the filing of this PAD, City Light requested designation from FERC as the non-federal representative for purposes of the Section 106 process to evaluate the NRHP eligibility of cultural resources and assessing Project effects on historic properties. Many portions of the Project Boundary and recently acquired fish and mitigation lands have not been surveyed to date. City Light will conduct a survey in the APE for historic properties potentially affected by the Project under the new license.

5.3.23.2 Goals and Objectives of the Section 106 Process

The goal of this study is to provide sufficient information to assist FERC in compliance with Section 106 of the NHPA and other cultural resources regulations. The objectives are as follows:

- Identify cultural resources within the APE.
- Identify potential Project effects on those cultural resources identified within the APE.
- Determine the NRHP eligibility of impacted cultural resources identified within the APE.

If evaluations of NRHP eligibility cannot be completed for cultural resources identified in the APE, then a phased approach as outlined in 36 CFR § 800.4(b)(2) would be implemented as part of the Skagit ARMMP and HRMMP.

5.3.23.3 Geographic Scope

The geographic scope for this study will be the APE for the Project, which will be defined in collaboration with the LPs and include lands and waters within the Project Boundary, the bypass reach and recently acquired fish and wildlife mitigation lands that are outside the current Project Boundary. The APE for the Project has yet to be defined. City Light is working with the LPs to define the APE in the Proposed Study Plan beginning with the Project footprint and known Project effects and activities. This study will incorporate information from other studies on geomorphology/erosion, ambient noise and light, and Project access routes for maintenance activities to aid in refining the geographic scope of potential effects to cultural resources.

5.3.23.4 Summary of Survey Methods and Approach

The proposed methodology complies with standard Section 106 procedures and guidelines published online by the DAHP and will be undertaken after the APE is defined. The first step will be to develop a survey plan that includes the specific methods and models that will be used for the cultural resources survey in the APE.

The survey plan will prioritize areas in the APE for field survey based on identification of areas with high probability for containing archeological resources and areas of existing or known potential project effects.

Within these two priority categories the survey plan will identify those areas that have not been previously surveyed and that are on landforms that have a high potential for the presence of cultural resources.

The identification of field survey areas will draw on information derived from the Cultural Resources Data Synthesis Study including quantitative data for the distribution of sites by major landform types in and above Ross Lake.

5.3.24 Gorge Bypass Reach Cultural Resources Survey

5.3.24.1 Summary of Issue

The 2.5-mile bypass reach between Gorge Dam and Gorge Powerhouse is considered to have moderate to high potential for occurrence of cultural resources, some of which may be considered historic properties. The Gorge bypass reach, which will be part of the APE for relicensing, has not been subjected to a comprehensive cultural resources survey.

5.3.24.2 Goals and Objectives of Study

The goal of this study is to assess the potential effects of the Project's operation and maintenance on cultural resources within the Gorge bypass reach that are included in or eligible for listing in the NRHP. The objectives are as follows:

- Identify cultural resources within the bypass reach.
- Evaluate potential Project effects on those resources that are listed in or eligible for listing in the NRHP (e.g., historic properties).
- Evaluate the NRHP eligibility of impacted cultural resources.

Results will be relevant to the Cultural Resources Survey described in Section 5.3.23 of this PAD.

5.3.24.3 Geographic Scope

The study area includes the 2.5-mile bypass reach from Gorge Dam to the Gorge Powerhouse.

5.3.24.4 Summary of Study Methods and Approach

Study methods include defining the survey area, collecting information on historic properties and Project operations and activities that could cause effects, and evaluating potential Project effects on any historic properties identified.

- Conduct literature review of available background information.
- Delineate study area of the bypass reach.
- Develop field survey plan, considering safe access and probability of cultural resources occurrence.
- Complete initial evaluation of NRHP eligibility for Project-effected archeological and built resources, if possible.

5.4 Management Plan Development

In 2019, during the Collaborative Study Plan Development Process, LPs and City Light identified some issues that are of shared interest but are either not directly related to information needs for the relicensing or do not need additional study to move forward with management actions to address the issue. For these issues, City Light has agreed to work with LPs to develop management plans to be included in the license application rather than pursue additional studies during relicensing.

5.4.1 Fire Management Plan

5.4.1.1 Summary of Issue

Decades of wildfire suppression policy have resulted in many regional forests with large accumulations of fuels that increase the likelihood of large wildfires. Wildfire has the potential to threaten City Light facilities and human safety, especially as climate change increases the frequency and severity of heat waves, seasonal droughts, and pest and disease outbreaks. The NPS wants to develop a Fire Management Plan specific to the RLNRA. The NPS envisions that the RLNRA Fire Management Plan will include both manual forest management and managed fire prescriptions to improve forest conditions and wildlife habitat, reduce fuels near infrastructure (City Light, NPS, and WSDOT), and improve defensibility of structures and public safety.

City Light operation and maintenance of the Project has limited direct effects on area wildfire fuels given that it is generally limited to vegetation management practices within the transmission line ROW, in town sites, and immediately adjacent to the other Project facilities. However, City Light recognizes that the presence of the Project means that NPS and other agencies, in addition to City Light, need to respond to and suppress fires to protect life and infrastructures in the Project vicinity.

City Light wants to reduce the risk of future wildfires endangering human safety or threatening its infrastructure and therefore has an interest in supporting the NPS in developing a RLNRA Fire Management Plan that includes scientifically-sound, proactive management approaches to reducing wildfire severity and the negative effects of wildfire near the Project.

5.4.1.2 Goals and Objectives of Management Plan

The goal of supporting the NPS's Fire Management Plan update is to ensure that management prescriptions developed to improve defensibility of City Light and NPS infrastructure utilize current vegetation data and factor in City Light operational considerations. Specific objectives are to identify and fill data gaps (e.g., appropriate vegetation plot data) and to assess current and future fire risk and effectiveness of mechanical fuel management prescription options near City Light infrastructure and Hozomeen.

5.4.1.3 Geographic Scope

Areas of interest to City Light include the RLNRA from just east of Ross Dam downriver to Goodell Creek. Assessment of mechanical fuel reduction prescriptions would be limited to more accessible areas near town sites, the ELC, dams/powerhouses, Hozomeen, and possibly other sites along the transmission line.

5.4.1.4 Summary of Methods and Approach

City Light intends to collaborate with the NPS to develop a Fire Management Plan that NPS would implement during the new license period in RLNRA. It is anticipated that the Fire Management Plan will include forest management prescriptions (mechanical and fire) that are based on model results. City Light will work with NPS and other agencies to develop: (1) cooperatively implemented fire prevention measures; and (2) wildfire response coordination procedures.

The steps in developing the information needed for an updated Fire Management Plan include the following:

- Work with NPS to select a forward-looking fire behavior and spread modelling approach to simulate fires in areas subjected to a range of mechanical forest management prescriptions and reignited, late-season managed fires (e.g., re-ignition of historically suppressed fires in safe locations) aimed at reducing fuel loads and increasing forest patch heterogeneity on the landscape in the vicinity of Project facilities.
- Support NPS and USFS Pacific Wildland Fire Sciences Lab in their analysis of modeling results.
- Review NPS-produced report that presents methods and results of the modeling and recommends actions for NPS to include in their RLNRA Fire Management Plan.

The following existing data will be used as inputs to the fire spread and fire behavior models:

- Canopy and fuel loads from North Cascades National Park Complex fuels and vegetation mapping data (to be shared)
- RAWS Remote Automated Weather Station data
- PRISM climate data (when RAWS data are not available)
- LANDFIRE data (to supplement fuels and vegetation mapping data)

The following steps will be taken to fill information gaps, and conduct analyses:

- NPS fire ecologists, City Light ecologists and fire response staff, and USFS Pacific Wildland Fire Sciences Lab staff will meet to refine assessment areas, confirm existing data availability, identify data gaps, and confirm modeling approach.
- NPS crews will collect any necessary field data and fill data gaps (e.g., additional vegetation and fuel loading data). NPS crews will establish permanent plots and collect vegetation and fuels data (fire effects monitoring data) within the treatment units using forest and fuels inventory protocols as described in the NPS *Fire Monitoring Handbook* (USDI NPS 2003).
- NPS will work with the USFS Pacific Wildland Fire Sciences Lab to use standard fire behavior and spread computer models to simulate effectiveness of various potential fuel treatment prescriptions in each mechanical treatment area and re-ignited fires at selected locations under a range of weather conditions (current vs. future [e.g., 2050 – 90th percentile fire weather data with accelerated wind speeds and reduced fuel moistures]).
- NPS will provide a report that includes:

- All findings, including methods, fire behavior, and fire spread results. Interpretation of which mechanical and intentional fire ignitions are most effective and feasible;
- Pre- and post-fire spread maps of simulated fires using spread model; and
- Pre and post-fire behavior outputs: flame length, crowning index, torching index, reaction intensity, rate of spread, and fire type from fire behavior model.
- Recommended actions for inclusion in a RLNRA Fire Management Plan.

5.4.2 Aquatic Invasive Species Management Plan

5.4.2.1 Summary of Issue

AIS are aquatic organisms that invade ecosystems beyond their natural, historical range. Their presence may harm native ecosystems or commercial, agricultural, or recreational activities dependent on these ecosystems. Introductions of AIS can be intentional or unintentional and AIS can be spread in many ways including by ships, boats, barges, aquaculture, aquatic recreation (fishing, hunting, boating, diving, etc.), water gardening, seaplanes, and via connected waterways. Through these and other means, thousands of invasive species have been introduced into the country costing billions of dollars, annually (USFWS 2019).

The Skagit River Project is comprised of three reservoirs (Ross, Diablo, and Gorge) which are open to recreational use including fishing, boating, day-use activities, and camping. Recreational visitors to Project reservoirs are potential vectors and increase the potential risk of introduction, colonization, and establishment of AIS.

Currently, the AISU at WDFW monitors waterbodies throughout Washington to detect the occurrence of AIS. The goal of the program is to prevent the spread of non-native aquatic nuisance species. Sampling conducted by AISU in lentic waterbodies includes plankton net tows, placement of artificial substrates that can be colonized by invasive species, visual shoreline observations, water quality measurements (including calcium levels), and collection of eDNA samples. The frequency of sampling at various sites is based on a risk assessment that includes over 17 variables such as ease of lake or reservoir access, numbers of boat ramps and docks, calcium levels, and local watershed land uses. AISU monitors for the following invasive species when conducting its surveys: zebra mussel (*Dreissena polymorpha*), quagga mussel (*D. bugensis*), Asian clam (*Corbicula fluminea*), Chinese mystery snail (*Bellamya chinensis*), New Zealand mudsnail (*Potamopyrgus antipodarum*), red swamp crayfish (*Procambarus clarkii*), virile crayfish (*Orconectes virilis*), rusty crayfish (*O. rusticus*), ringed crayfish (*O. neglectus*), and Sanborn's crayfish (*O. sanbornii*).

A number of sites are monitored by AISU in the Skagit River basin; sites in the Project Boundary include Colonial Creek Campground in Diablo Lake, NPS "Old Ramp South" in Ross Lake, and Winnebago Flats in Ross Lake. These sites have a low risk rating based on the AISU risk assessment and are visited one time per year. In Diablo Lake, annual sampling began in 2007. In Ross Lake, sampling began in 2019 (Schultz 2019a; 2019b). AISU plans to continue sampling annually at the three sites identified above.

While aquatic invasive fish species have been documented within the Project Boundary and include Brook Trout and Redside Shiner[43] (found in all three reservoirs) (see Section 4.5.1.5 of this PAD), the focus of this management plan is on invertebrate AIS (e.g., mussels, snails, and clams). Monitoring conducted by the AISU indicate that none of the invertebrate AIS noted above have been documented in the Project Boundary. However, City Light recognizes that the potential ecological and economic impacts of AIS introduction are significant and that monitoring and management of AIS in the Project and broader Skagit River Basin are a shared interest and responsibility amongst numerous agencies and organizations including City Light.

5.4.2.2 Goals and Objectives of Management Plan

The goal of the AISMP is to prevent the introduction and/or spread of aquatic nuisance species in Project waters.

Specific objectives of this management plan are as follows:

- Develop a monitoring program to identify AIS that establish in the Project reservoirs.
- Provide for education outreach activities within the Project.
- Ensure that the Project is included in regional and state efforts to prevent the introduction and spread of aquatic nuisance species.
- Develop an early detection and rapid response plan.

This AISMP is intended to be compatible with other aquatic invasive species management activities in the Skagit River Basin.

5.4.2.3 Geographic Scope

The geographic scope of the AISMP includes areas within the Project Boundary including Project reservoirs and shorelines, at dams, and Project recreational facilities (e.g., boat launches, etc.).

5.4.2.4 Summary of Methods and Approach

Methods will support AIS monitoring objectives:

Install plankton net tows, place artificial substrates that can be colonized by invasive species, conduct visual shoreline observations, and monitor bycatch data collected during other fish and aquatic management activities. The ability to identify and eradicate any AIS found in the Project Boundary will be facilitated by preparing an Early Detection and Rapid Response Plan and updating this plan on a periodic basis to consider new technologies and approaches.

The following activities will support education and outreach objectives:

- Develop and make available information regarding the effects of AIS introductions and the importance of prevention available to the public. Outreach activities may consist of posting signage at Project recreation areas and boat launches.
- Coordinate with the ELC and other entities within the Skagit River basin to help facilitate AIS

[43] Redside Shiner are native to the lower Skagit River but were accidentally introduced to Ross Lake and are considered an invasive species upstream of Gorge Dam.

Prevention education opportunities.

The following activities will support regional coordination efforts:

- Coordinate activities and share information with WDFW AISU.
- Participate in regional cooperative efforts aimed at preventing the spread of AIS (e.g., 100th Meridian Initiative).

5.4.3 Ross Lake Cultural Resources Erosion Management Plan

5.4.3.1 Summary of Issue

The existing Skagit ARMMP does not address concerns that agencies and tribes have regarding the effects of Project-related geomorphic changes on archaeological resources in the Ross Lake area.

5.4.3.2 Goals and Objectives of Study

The goal of the Ross Lake Cultural Resources Erosion Management Plan is to determine if the methods currently included in the Skagit ARMMP adequately protect archaeological sites in the Ross Lake area. The objectives are to:

- Develop a monitoring plan that can be integrated into an updated Skagit ARMMP.
- Identify methods to evaluate the potential effects of Project-related geomorphic changes on NRHP-listed, eligible, or unevaluated archaeological resources within the Ross Lake portion of the APE.
- Implement the methods to evaluate short- and long-term effects on archaeological sites that are listed, eligible, or unevaluated for listing in the NRHP within the Ross Lake portion of the APE.
- Develop appropriate protection and treatment options to avoid or minimize any adverse effects to archaeological sites that are listed or eligible for listing in the NRHP. Project effects on those resources that would be determined NRHP-eligible or NRHP-listed would be assessed after their eligibility is determined.
- Inform meaningful mitigation for any adverse effects that cannot be avoided.

5.4.3.3 Geographic Scope

The management plan is focused on Ross Lake.

5.4.3.4 Summary of Study Methods and Approach

The management plan will identify and evaluate analytical methods to quantify geomorphic changes that may be affecting archaeological sites in the Ross Lake area that are listed, eligible, or unevaluated for listing in the NRHP. Data will be tabulated from previous work, and new methods of data collection will be included as appropriate. Confidential information will not be available for public disclosure.

- Research similar projects (i.e. reservoirs with archaeological sites) and review what methods have been effective in protecting sites from erosion. Determine if these methods, equipment, and technology might be applied to Ross Lake. City Light has begun this work during the current Project license term.

- Conduct archival research into NPS records and particularly the photographic collection. Use data from those records to see which categories of information can be compared site-to-site or over time.
- Research geomorphology and erosion studies on Ross Lake that could inform this study and have a geomorphologist evaluate Ross Lake conditions to help formulate and ground test the study methods.
- Use LIDAR and other imaging data to determine if large-scale changes can be correlated to site-specific changes.
- Use LIDAR and imaging data to establish confidential georeferenced locations for monitoring archaeological site changes. For example, photo points can be identified where photos can be taken from the same location, elevation, and direction season to season and year to year using a reliable landmark or GPS locale that makes the comparisons relevant.
- Perform fieldwork to test and refine data collection methods to add quantitative measurements. Where appropriate, use measuring tools such as erosion pins, which can be set near archaeological sites without jeopardizing subsurface evidence or public awareness of site locations.
- Periodically revise and integrate new or improved methods into the Skagit ARMMP.

5.4.4 Ross Lake Woody Debris Management Plan

5.4.4.1 Summary of Issue

Large woody debris in streams and rivers benefits fish and other aquatic organisms by influencing habitat quality, hydraulic complexity, shoreline stability, and retention of organic matter and nutrients. Annually, woody debris accumulates in Ross Lake and poses recreational and dam safety hazards. Relocating woody debris from Ross Lake is complicated, expensive, and inefficient due to a variety of constraints. The most significant of these is lack of highway access. Consequently, City Light has determined that the current methods used to relocate woody debris from Ross Lake should be improved upon. Under the current license, City Light relocates large, high-quality woody debris from Ross Lake to the Skagit River downstream of the Project. The proposed management plan will identify a sustainable, cost-effective method for removing small, low-quality woody debris from Ross Lake.

5.4.4.2 Goals and Objectives of Management Plan

City Light will continue its current program for relocating high quality, large woody debris from Ross Lake to the Skagit River downstream of Gorge Dam using existing collection and transport methods. The goal of the Ross Lake Woody Debris Management Plan (WDMP) is to identify and develop a sustainable, cost-effective method for managing the remaining woody debris collected in Ross Lake. City Light is interested in exploring alternatives that can use some or all of the accumulated low-quality woody debris in a sustainable way.

Specific objectives of the Ross Lake WDMP are listed below:

- Provide background summary of current woody debris management operations and a brief overview of alternatives presented of the Ross Lake Debris Disposal Study – Final Report (Zapel 2019).
- Identification and analysis of additional alternatives, if necessary.
- Identification of a preferred cost-efficient, safe, and sustainable method or methods of managing small, low quality woody debris collected in Ross Lake.
- Development of a plan and schedule for a pilot woody debris removal and transport program, including acquisition of the necessary permits.
- Development of a monitoring program to document that the pilot debris removal program, evaluate the program's effectiveness and sustainability, and provide for adaptive management.

5.4.4.3 Geographic Scope

The geographic scope of the Ross Lake WDMP is the Project reservoirs.

5.4.4.4 Summary of Methods and Approach

The following potential management alternatives for low-quality woody debris will be further evaluated for feasibility:

- Open burning.
- Burning in air-curtain burn boxes.
- Processing into a marketable product (e.g., hog fuel, pellets, or briquettes).
- Processing into mulch.
- Removal via mobile skyline from Ruby Arm to SR 20.
- Syngas production to supply remote facilities (e.g., Hozomeen).
- Hauling via boat and dump truck for release into the river downstream of the Project.
- A combination of two or more of the alternatives identified above.

City Light will select, based on economic viability and technical feasibility, a subset of the alternatives identified above. This subset of alternatives would be analyzed in greater depth than the basic concept-level assessment provided in Zapel (2019). This second-level assessment (of a subset of alternatives) would be discussed and evaluated in consultation with LPs to identify the alternative or combination of alternatives that is both economically viable and acceptable to the resource agencies in the context of their respective management priorities and permitting authority.

The Ross Lake WDMP will include: (1) a rationale for the alternative to be evaluated during a pilot program; (2) a description of the process for securing all permits needed to conduct the pilot program; (3) a monitoring program to confirm that the pilot program was conducted according to plan and verify that the pilot program is effective; and (4) an approach for converting the pilot program to a long-term management solution for Ross Lake woody debris, which will include an adaptive management component.

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6.0 RELEVANT COMPREHENSIVE PLANS

As detailed in FERC's List of Comprehensive Plans (revised December 2019), Section 10(a)(2)(A) of the FPA requires FERC to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project.

On April 27, 1988, FERC issued Order No. 481-A establishing that FERC will accord the FPA Section 10(a)(2)(A) comprehensive plan status to any federal or state plan that:

- Is a comprehensive study of one or more of the beneficial uses of the waterway or waterways;
- Specifies the standards, the data, and the methodology used; and
- Is filed with the Secretary of FERC.

According to FERC, a comprehensive plan should contain the following: (1) a description of the waterway or waterways that are the subject of the plan including pertinent maps detailing the geographic area of the plan; (2) a description of the significant resources of the waterway or waterways; (3) a description of the various existing and planned uses of the resources; and (4) a discussion of goals, objectives, and recommendations for improving, developing, or conserving the waterway or waterways in relation to these resources. The description of the significant resources in the area should contain the following elements. The plan should also contain an examination of how the different uses will promote the overall public interest:

- Navigation
- Power development
- Energy conservation
- Fish and wildlife
- Recreational opportunities
- Irrigation
- Flood control
- Water supply
- Other aspects of environmental quality

FERC (December 2019) currently lists 95 comprehensive plans for the State of Washington. Of these 95 listed plans, 19 are potentially relevant to the Skagit River Project vicinity; each plan is listed below with a brief explanation for its inclusion as a relevant qualifying comprehensive plan. The comprehensive plans and corresponding published dates identified in the sections below are consistent with FERC's list of comprehensive plans. The descriptions indicate when a plan has been updated. Comprehensive plans relevant to the Skagit River Project vicinity, but not included on FERC's list, are identified in the relevant resource sections of this PAD (4.3 through 4.12). Based on a review of the 19 potentially relevant comprehensive plans, City Light believes that the Project as currently operated is consistent with each of these plans.

6.1 Interagency Committee for Outdoor Recreation. 2002. Washington State Comprehensive Outdoor Recreation Planning Document (SCORP): 2002-2007. Olympia, Washington. October 2002. *[Updated in 2018 for 2018-2022].*

The 2018-2022 Recreation and Conservation Plan for Washington State provides a strategic direction for how local, regional, state, and federal agencies, together with tribal governments, and private and non-profit partners, can ensure the effective and adequate provision of outdoor recreation and conservation to meet the needs of Washington State residents.

6.2 Interagency Committee for Outdoor Recreation. 1995. Washington State Outdoor Recreation and Habitat: Assessment and Policy Plan 1995-2001. Tumwater, Washington. November 1995.

This plan was developed per direction in RCW 43.99.025(3), which calls for the Interagency Committee for Outdoor Recreation to "*prepare and update a strategic plan for the acquisition, renovation, and development of recreational resources and the preservation and conservation of open space.*" This plan also maintains the state's eligibility to participate in the federal Land and Water Conservation Fund program.

6.3 Interagency Committee for Outdoor Recreation. 1991. Washington State Trails Plan: Policy and Action Document. Tumwater, Washington. June 1991. *[Updated in 2013 for 2013-2018].*

This plan offers strategic direction for establishing a system of state recreation trails in Washington State for the next 5 years. This plan is a separate but complementary plan designed to support the SCORP adopted in 2013 by providing specific guidance on trails route planning, designation, and coordination.

6.4 National Park Service. 1993. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.

The Nationwide Rivers Inventory (NRI) is a listing by USDOI, NPS of more than 2,400 free-flowing river segments in the U.S. that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance. In addition to these eligibility criteria, river segments are divided into three classifications: Wild, Scenic, and Recreational river areas. Under a 1979 Presidential Directive and related Council on Environmental Quality procedures, all federal agencies must seek to avoid or mitigate actions that would adversely affect one or more NRI segments. Such adverse impacts could alter the river segment's eligibility for listing and/or alter its classification.

6.5 National Park Service. 2005. North Cascades National Park Complex Fire Management Plan. Sedro-Woolley, Washington. May 2005. *[Updated in 2007].*

This document serves as the Fire Management Plan for the North Cascades National Park Complex, which includes North Cascades National Park, RLNRA, and Lake Chelan National Recreation Area. The Fire Management Plan provides guidance for fire managers at the local level while they implement national fire policy.

6.6 National Park Service. 2011. North Cascades National Park Complex Invasive Non-Native Plant Management Plan. Sedro-Woolley, Washington. November 2011.

This plan was developed to provide guidance for the control of invasive, non-native plants, restoration of impacted areas, and detection and prevention of new infestations within the North Cascades National Park Complex in an effort to protect the resources and values of the North Cascades ecosystem.

6.7 National Park Service. 2012. Ross Lake National Recreation Area General Management Plan. Department of the Interior, Seattle, Washington. 2012.

The purpose of the RLNRA GMP is to articulate a vision and management strategy for RLNRA over the next 15 to 20 years. This plan presents management strategies for resource protection and preservation, education, and interpretation, visitor use and facilities, land protection and boundaries, and long-term O&M of RLNRA. The GMP divides RLNRA into five management zones reflective of resource condition, level of development, and visitor experience. The five management zones are: (1) Frontcountry Zone; (2) Backcountry Zone; (3) Wilderness Zone; (4) Skagit River Zone; and (5) Hydroelectric Zone. The Skagit River Project is located in the Hydroelectric Zone and most visitor experiences are linked to learning about hydroelectricity and frontcountry recreational activities.

6.8 State of Washington. 1977. Statute establishing the State scenic river system, Chapter 79.72 RCW. Olympia, Washington.

The purpose of this statute is to establish a program for managing publicly owned land on rivers included in the state's scenic river system, to indicate the river segments to be initially included in that system, to prescribe a procedure for adding additional components to the system, and to protect the rights of private property owners.

6.9 U.S. Fish and Wildlife Service. n.d. Fisheries USA: the Recreational Fisheries Policy of the U.S. Fish and Wildlife Service. Washington, D.C.

This 12-page policy signed by John F. Turner, then Director of USFWS, on December 5, 1989 is intended to unite all of USFWS' recreational fisheries capabilities under a single policy to enhance the nation's recreational fisheries. Regional and Assistant directors are responsible for implementing the policy by incorporating its goals and strategies into planning and day-to-day management efforts. USFWS carries out this policy relative to FERC licensed hydroelectric projects through federal laws such as the Fish and Wildlife Coordination Act, Clean Water Act, ESA, NEPA, and the FPA, among others.

6.10 U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American Waterfowl Management Plan. Department of the Interior. Environment Canada. May 1986. *[Updated in 2018].*

The North American Waterfowl Management Plan, first published in 1986 and most recently updated in 2018 describes a scientific approach to waterfowl habitat restoration and protection through an international partnership-based model for conservation. Representative agencies and organizations from Canada, the United States, and Mexico have participated in the collaborative effort. USFWS is the principal agency responsible for managing and enhancing waterfowl species populations and habitat in the U.S.

6.11 U. S. Forest Service. 1990. Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan. Department of Agriculture, Seattle, Washington. June 1990.

This plan guides natural resource management activities and establishes management standards and guidelines for the Mt. Baker-Snoqualmie National Forest. The Plan describes resource management practices, levels of resource protection and management, and the availability and suitability of land for resource management.

6.12 Washington Department of Fish and Wildlife. 1997. Management Recommendations for Washington's Priority Habitats: Riparian. Olympia, Washington. December 1997. *[Updated in 2018].*

By virtue of its high productivity, diversity, continuity, and critical contributions to both aquatic and upland ecosystems, riparian habitat provides a rich and vital resource to Washington's fish and wildlife. Riparian habitat occurs as an area adjacent to rivers, perennial or intermittent streams, seeps, and springs throughout Washington. The Washington Department of Fish and Wildlife has developed statewide riparian management recommendations based on the best available science.

6.13 Washington Department of Fish and Wildlife. 1991-2018. Management Recommendations for Washington's Priority Species. Olympia, Washington. *[Multiple Volumes Updated in 2018].*

The WDFW has identified those fish and wildlife resources that are a priority for management and conservation. Priority habitats are those habitat types with unique or significant value to many fish or wildlife species. The department has developed management recommendations for Washington's priority habitats and species to provide planners, elected officials, landowners, and citizens with comprehensive information on important fish, wildlife, and habitat resources. These management recommendations are designed to assist in making land use decisions that incorporate the needs of fish and wildlife. Management recommendations for Washington's priority habitats and species are guidelines based on the best available scientific information and are designed to meet the following goals: (1) Maintain or enhance the structural attributes and ecological functions of habitat needed to support healthy populations of fish and wildlife; (2) Maintain or enhance populations of *priority species* within their present and/or historical range in order to prevent future declines; and (3) Restore species that have experienced significant declines.

6.14 Washington Department of Fish and Wildlife. 2005. Washington's Comprehensive Wildlife Conservation Strategy. Olympia, Washington. September 19, 2005.

WDFW is responsible for the protection and management of: all marine, anadromous and freshwater fish; shellfish; and terrestrial wildlife – thousands of animal species statewide. WDFW regulates all legal harvest of commercial fish, sportfish, and wildlife, enforces wildlife protection laws, and manages about 840,000 acres of land.

6.15 Washington Department of Game. 1987. Strategies for Washington's Wildlife. Olympia, Washington. May 1987.

The Washington Department of Game and the Washington Game Commission were established by the legislature in 1933 as directed by initiative 62. This legislation created Title 77 of the RCW, which is known as the Game Code. The Game Code declares wildlife to be the property of the people of the state and mandates the Department to "preserve, protect and perpetuate" Washington's wildlife while maximizing public recreation.

6.16 Washington Department of Natural Resources. 1987. State of Washington Natural Heritage Plan. Olympia, Washington. *[Updated in 2018].*

The Natural Area Preserves Act (RCW, Chapter 79.70) requires that the WNHP develop the State of Washington Natural Heritage Plan to identify conservation priorities and the processes by which potential Natural Areas are selected and approved. The plan lays the foundation and context that will help guide conservation of biodiversity in the state of Washington for people and nature.

6.17 Washington Department of Natural Resources. 1997. Final Habitat Conservation Plan. Olympia, Washington. September 1997.

This multi-species Habitat Conservation Plan was developed to address state trust land management issues relating to compliance with federal ESA (16 U.S.C. 1531 et seq.). The plan covers approximately 1.6 million acres of state trust lands managed by the Washington Department of Natural Resources within the range of the northern spotted owl.

6.18 Washington State Parks and Recreation Commission. 1988. Scenic Rivers Program – Report. Olympia, Washington. January 29, 1988.

Chapter 79.72 RCW passed by the 1977 legislature established a scenic river system for the state of Washington. The purpose of the law is to protect and preserve the natural character of the state's most scenic rivers. The Washington State Parks and Recreation Commission is directed to develop and adopt management policies for publicly owned or leased land on designated scenic rivers.

6.19 Washington State Parks and Recreation Commission. 1988. Washington State Scenic River Assessment. Olympia, Washington. September 1988.

The National Wild and Scenic Rivers System was authorized by Congress in 1968 for protection of outstanding rivers. The System currently comprises 72 rivers in the United States, including segments of the Skagit, White Salmon, and Klickitat in Washington. Rivers in the System are permanently protected from large dams and other types of development.

7.0 SUMMARY OF CONTACTS

Under its current Project license, City Light is actively engaged with LPs regarding resource management in the Project Boundary and surrounding area. In addition to regular coordination with current settlement parties, City Light hosted a relicensing information meeting with FERC and current settlement parties on September 20, 2017. Throughout 2017 and 2018, City Light held follow-up meetings with interested parties, including NMFS, NPS, USFS, USFWS, DAHP, Ecology, WDFW, Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, Hydropower Reform Coalition, NCI, and Skagit Environmental Endowment Commission, to introduce the upcoming relicensing of the Skagit River Project and request information regarding resource issues to be addressed during the relicensing.

Further, as described in Section 5 of this PAD, City Light engaged with a broad group of LPs to identify potential issues for study. This process included the sharing of background information between City Light and LPs that has been considered in the development of this PAD. Parties who participated in an October 30, 2018 informational meeting and site visit or any of the Collaborative Study Plan Development Process meetings are listed in Table 7.1. A list of meeting dates and resource area focus is provided in Table 7.2.

In addition, City Light held outreach meetings on October 10 and 15, 2019 to introduce federally-recognized tribes, including those who had not participated previously in license implementation and may have potential interest in the Project, to the upcoming relicensing process. Invitations and background information were sent to the Confederated Tribes of the Colville Reservation, Lummi Nation, Muckleshoot Indian Tribe, Nooksack Indian Tribe, Samish Indian Nation, Sauk-Suiattle Indian Tribe, Snoqualmie Indian Tribe, Stillaguamish Tribe of Indians, Swinomish Indian Tribal Community, Tulalip Tribes of Washington, and Upper Skagit Indian Tribe.

Table 7.1. Licensing participants engaged in 2019 during the Collaborative Study Plan Development Process.

Organization
Access Fund
American Rivers
American Whitewater
Hydro Reform Coalition
National Marine Fisheries Service (NMFS)
North Cascades Conservation Council (NCCC)
North Cascades Institute (NCI)
Sauk-Suiattle Indian Tribe
Skagit County Dike District Partnership (SCDDP)
Skagit Drainage and Irrigation District Consortium (SDIDC)
Skagit Environmental Endowment Commission (SEEC)
Skagit River System Cooperative (SRSC)
Swinomish Indian Tribal Community
Trout Unlimited
U.S. Fish and Wildlife Service (USFWS)

Organization
U.S. Forest Service (USFS)
U.S. Geological Survey (USGS)
U.S. National Park Service (NPS)
Upper Skagit Indian Tribe
Washington Climbers Coalition
Washington Department of Archaeology and Historic Preservation (DAHP)
Washington Department of Ecology (Ecology)
Washington Department of Fish and Wildlife (WDFW)

Table 7.2. 2019 and 2020 Resource Working Group and Steering Committee meetings.

Date	Title
January 29, 2019	Fish and Aquatic Resources and Cultural Resources Work Group Meeting
January 29, 2019	Recreation and Aesthetics and Terrestrial Resources and Reservoir Erosion Resource Work Groups Meeting
February 12, 2019	Steering Committee Meeting
March 18, 2019	Cultural Resources Work Group Meeting
March 18, 2019	Fish and Aquatic Resources Work Group Meeting
March 18, 2019	Recreation and Aesthetics Resource Work Group Meeting
March 19, 2019	Terrestrial Resources and Reservoir Erosion Work Group Meeting
April 9, 2019	Fish and Aquatic Resources Work Group Meeting
April 15, 2019	Fish and Aquatics Geomorphology Subgroup Meeting
April 17, 2019	Steering Committee Meeting
May 20, 2019	Fish and Aquatic Resources Work Group Meeting
May 21, 2019	Cultural Resources Work Group Meeting
May 21, 2019	Terrestrial Resources and Reservoir Erosion Work Group Meeting
May 22, 2019	Recreation and Aesthetic Resources Work Group Meeting
May 28, 2019	Fish and Aquatics Geomorphology Subgroup Meeting
June 19, 2019	Steering Committee Meeting
June 25, 2019	Fish and Aquatics Geomorphology Subgroup Meeting
July 29, 2019	Fish and Aquatic Resources Work Group Meeting
July 30, 2019	Terrestrial Resources and Reservoir Erosion Work Group Meeting
July 31, 2019	Recreation and Aesthetic Resource Work Group Meeting
August 7, 2019	Cultural Resources Work Group Meeting
September 4, 2019	Steering Committee Meeting
October 3, 2019	Fish Passage Subgroup Meeting
October 15, 2019	Terrestrial Resources and Reservoir Erosion Work Group Meeting
October 16, 2019	Cultural Resources Work Group Meeting
October 30, 2019	Fish Passage Subgroup Meeting
November 6, 2019	Steering Committee Meeting
December 5, 2019	Steering Committee Meeting
January 23, 2020	Steering Committee Meeting

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Section 6.0

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Section 7.0

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